Exhibit H

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

COMCAST CABLE COMMUNICATIONS, LLC,
Petitioner,

v.

ENTROPIC COMMUNICATIONS, LLC.,
Patent Owner.

Patent No. 10,135,682
Filing Date: January 9, 2018
Issue Date: November 20, 2018
TITLE: METHOD AND SYSTEM FOR SERVICE GROUP MANAGEMENT IN A CABLE NETWORK

Inter Partes Review No.: IPR2024-00445

DECLARATION OF SAYFE KIAEI

IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.100 *et seq.*

Declaration in Support of Petition 2 of 2

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I, Sayfe Kiaei, declare that I have personal knowledge of the facts set forth in this declaration and, if called to testify as a witness, could and would do so competently.

I. INTRODUCTION

1. I have been retained as an expert witness on behalf of the Petitioner, Comcast Cable Communications, LLC, for the above-referenced *inter partes* review proceeding.

2. I have been asked to provide a declaration regarding certain matters pertaining to U.S. Patent No. 10,135,682 ("the '682 patent") (Ex. 1101) and the unpatentability grounds set forth in the Petition for this proceeding. I understand the '682 patent is owned by Entropic Communications, LLC.

3. I am being compensated at my usual consulting rate of $685 per hour for my work on this matter. My compensation is in no way dependent upon my opinions or testimony or the outcome of this proceeding. I have no financial interest in the parties or in the outcome of this proceeding.

II. PROFESSIONAL BACKGROUND AND QUALIFICATIONS

A. Qualifications

4. A full description of my educational background, professional achievements, qualifications, and publications in the past 30+ years are set forth more fully in my curriculum vitae, which is attached to this Declaration as Exhibit 1003. Here, I provide a brief summary of my background and qualifications.

5. I received my Ph.D. in Electrical and Computer Engineering from Washington State University in 1987. My dissertation research areas were in signal processing, communication system, and networks. I have several patents and over 200 journal and international conference publications. I have graduated over 100 MS and PhD students working under my supervision on their thesis, and many of them are professors in academia or have senior positions in industry. My research is funded by various sources, including industry and federal agencies, such as NSF, USAID, DARPA, JPL, and NASA.

6. Since 2001, I have held the position of Motorola[1] Endowed Chair Professor in communication and RF system at the School of Electrical, Computer, and Energy Engineering at Arizona State University ("Arizona State") in Tempe, Arizona.

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[1] This position refers to a historical endowment established in 1998 for supporting communication, manufacturing, and supply chain programs at Arizona State. The objective of this endowment was to strengthen Arizona State's capabilities in these technologies. Three other Arizona State professors have this endowment title in manufacturing, communication, and supply management. I do not receive any funding from Motorola and have not since I joined Arizona State.

7. I am also the Director of the National Science Foundation Center, Connection One. Connection One is a research center focused on developing wireless communication system and networking technologies.

8. I have been involved in research, teaching, and developing products in the areas of communications, networking, wireless systems, satellite systems, analog and digital circuits, linear and switching power management integrated circuits (PMIC), sensors, electronics, and related areas for the last 30 years.

9. From 1987 to 1993, I was an assistant and tenured associate professor at Oregon State University ("Oregon State").

10. From 1997 to 2002, I was also an adjunct professor at the University of Texas at Austin.

11. At Oregon State, the University of Texas, and Arizona State, I taught courses in the areas of communication systems; wireline systems, wireless systems; networks; systems and circuits; digital integrated circuits, including HDL, Verilog, and VHDL; digital signal processing; and related areas.

12. At Arizona State, I also developed a new course on wireless transceiver systems. I have been doing research in the wireline and wireless communication and transceiver design. I joined Arizona State in 2001. My research has been funded by the National Science Foundation, DOD, DARPA, and industry in the wireless communication system.

13. In industry and academia, I have been working on wireline communication systems including DSL, MODEMS, CABLE MODEM, DOCIS, and wireless communication including cellular (1G, 2G, 3G, 4G-LTE, 5G), land-mobile, satellite communication, ZIGBEE, Bluetooth, WiFi, wireless sensors since 1990.

14. I have been involved in research, teaching, and developing products in the areas of communication system, DSL, Cable MODEM, T1/E1, LAN, WAN, 2-way radios, Land-Mobile radio systems, cellular systems, GPS, location, RF Integrated circuits, Analog and Digital Integrated Circuits, HDL, Verilog, VHD, communications, digital signal processing, and related areas for the last 30 years, starting with the first generation of mobile phones.

15. I have also worked on second generation (2G) and third generation (3G) mobile phone technologies including GSM, EDGE, IS-95, 1X CDMA, UMTS, Wide band CDMA, GPS, Bluetooth, and related areas. These terms all refer to leading mobile phone standards and technologies, which enjoyed widespread use in mobile telephone networks throughout the world. I have also worked on other wireless data communication technologies including Bluetooth, the global positioning system (GPS), Wireless local area networks (LAN) (often known as WiFi), and related areas.

16. I have written and reviewed software code in HDL, Assembly, C, C++, DSP code, and MATLAB for processors. I have written, debugged, and reviewed software code for DSL, embedded microprocessors, and processors used for both wireline and wireless transceivers at Motorola, ASU, and as an expert witness.

17. From 1993-2002, I worked at Motorola and worked at the Land-mobile products Sector (LMPS), wirelines transceivers, and Wireless integrated Technology Center.

18. At Motorola LMPS, and cellular group, I was responsible for the design and development of system, architecture, DSP, analog, and RF integrated circuits for 1G (AMPS, Digital AMPS), 2-way radios, 2G (GSM, EDGE), and 3G (CDMA, WCDMA / UMTS, CDMA2000) transceiver. The products were Motorola flip phone, Razor, iDEN, etc. At LMPS, I worked in the Land-Mobile Products Sector (LMPS) and cellular group. I have designed and contributed to the design of many communications wireless systems including 2-way radios, trucking systems, 2-way radios, land-mobile products, satellite communications, cellular systems, GPS and Bluetooth.

19. I also worked on the interaction of the Iridium satellite system with the cellular and LAN system networking.

20. At Motorola Telecomm group, I worked on a single chip DSL transceiver "COPPERGOLD", cable modem transceiver (DOCIS I and II) and other

wireline systems. I represented Motorola and regularly attended many standards including ITU (International Telecommunication Unit), ETSI (European Telecommunications Standards Institute), and other standards as a technical expert.

21. I have over 200 journal and conference publications, 13 patents, and standards contributions. Several of these patents and publications are in the areas of communications, networking and radio systems. At Oregon State, UT, and Arizona State, I taught courses and researched in the areas of communication system, cellular system, land-mobile communication system, analog and digital integrated circuits, power management integrated circuits (PMIC), communication systems; radio frequency ("RF") systems and circuits; ("RFID"); magnetic and electronic sensors; including HDL, Verilog, and VHDL; digital signal processing; and related areas. The list of my publications is included in my resume in Exhibit 1003.

22. I have been an active member of IEEE communication, radio frequency, and networking societies since 1985 and have published, organized sessions, and been on various IEEE committees. I am an IEEE Fellow, which is the highest level of IEEE membership awarded by the IEEE directors to recognize a high level of demonstrated extraordinary accomplishments. The IEEE Fellow Award is a special recognition for members with extraordinary accomplishments in the IEEE technical fields. To ensure that the recognition is extraordinary, the total number of recipients each year cannot exceed 0.1% of the total higher grade

membership. The IEEE is the Institute of Electrical and Electronics Engineers, the world's largest association of technical professionals whose objectives include the educational and technical advancement of electrical and electronic engineering, telecommunications, computer engineering, and related disciplines.

23. I am a member of the IEEE Circuits and Systems Society, IEEE Solid State Circuits Society, IEEE Signal Processing Society, and IEEE Communication Society. I am also a member of the IEEE RF and Microwave committees, IEEE Low Power Symposium Committee, and IEEE Fellow Selection Committee. I was one of the key organizers establishing the IEEE Radio Frequency Integrated Circuits (RFIC) symposium in 1995, and I have been on the executive and technical committees of RFIC for the last 16 years.

24. I have received several awards including the Carter Best Teacher Award, the IEEE Darlington Award (which is given for the best technical paper on circuits and systems in the IEEE Circuits and Systems Society), and the Motorola 10X Rapid Design Cycle Reduction Award.

III. MATERIALS CONSIDERED

25. In formulating my opinion, I reviewed and considered U.S. Pat. No. 10,135,682.

26. In preparing this declaration, I also reviewed and considered the Petition and the file history (Ex. 1104) of the '682 patent (Ex. 1101) as well as the following references:

- Ex. 1105: U.S. Patent Application Publication No. 2007/0223512 ("Cooper")
- Ex. 1107: U.S. Patent Application Publication No. 2005/0111535 ("Saey")
- Ex. 1108: U.S. Patent Application Publication No. 2004/0085987 ("Gross")
- Ex. 1109: U.S. Patent Application Publication No. 2006/0274825 ("Cioffi")
- Ex. 1110: U.S. Patent Application Publication No. 2013/0041990 ("Thibeault")
- Ex. 1112: U.S. Patent No. 10,084,538 ("Nielsen-538")
- Ex. 1113: Reserved
- Ex. 1114: U.S. Patent No. 8,085,802 ("Monk-802")
- Ex. 1115: U.S. Patent No. 7,573,822 ("Monk")
- Ex. 1116: U.S. Patent No. 6,772,437 ("Cooper-437")

- Ex. 1117: Claim Construction Memorandum Opinion and Order, *Entropic Comms., LLC v. Charter Comms., Inc.*, Case No. 2:22-CV-00125-JRG
- Ex. 1118: Rebuttal Expert Report of John Holobinko Regarding Validity of U.S. Patent Nos. 8,284,690 and 10,135,682
- Ex. 1119: Exhibit F, U.S. Patent No. 10,135,682 Exemplary Infringement Chart
- Ex. 1120: Reserved
- Ex. 1121: Data-Over-Cable Interface Specifications, Radio Frequency Interface Specification, SP-RFII01-970326
- Ex. 1122: Data-Over-Cable Service Interface Specifications, DOCSIS 1.1, Radio Frequency Interface Specification, CM-SP-RFIv1.1-C01-050907 ("DOCSIS 1.1")
- Ex. 1123: Data-Over-Cable Service Interface Specifications, DOCSIS 2.0, Radio Frequency Interface Specification, CM-SP-RFIv2.0-C02-090422 ("DOCSIS 2.0"
- Ex. 1124: U.S. Patent Application Publication No. 2007/0171994 ("Parker")
- Ex. 1125: U.S. Patent App. No. 8,503,546 ("Ashrafi")
- Ex. 1126: Tanenbaum, "Computer Networks," 4th ed. (2003).

- Ex. 1126: Tanenbaum, "Computer Networks," 4th ed. (2003).
- Ex. 1127: Driscoll, "Next Generation IPTV Services and Technologies" (2008)

IV. UNDERSTANDING OF APPLICABLE LEGAL STANDARDS

27. Although I am not an attorney, I have a general understanding of the applicable legal standards pertaining to the patentability issues presented in this proceeding.

28. I understand that, in this *inter partes* review (IPR), Petitioner is challenging the patentability of the claims of the '682 patent. I understand that Petitioner has the burden of proving that each challenged claim is unpatentable by a preponderance of the evidence.

29. I understand that to be valid, a patent claim must be "novel," and is invalid if "anticipated" by a single prior art reference. I further understand that a reference anticipates if it discloses each and every element as arranged in the claim, so as to enable a person of ordinary skill in the art ("POSITA") to make and use the claimed invention without undue experimentation.

30. I understand that a patent claim is unpatentable if, at the time of the invention, it would have been obvious to a POSITA to combine the teachings of the prior art to yield the patent claim. I also understand that it is not required (although it is acceptable) that each element/limitation of a patent claim be found in a single

reference in order to find a patent claim obvious. For a patent claim to be found obvious, all the elements/limitations of the patent claim may be found in a combination of references at which a person of ordinary skill in the art would have been reasonably expected to arrive. I understand that a proper analysis of whether an invention is unpatentable for obviousness includes a review of the scope and content of the prior art, the differences between the patent claims at issue and the prior art, the level of ordinary skill in the field of the invention at the time of the invention, and other objective considerations identified below.

31. It is my understanding that the prior art and claimed invention should be viewed through the knowledge and understanding of a person of ordinary skill in the art—one should not use his or her own insight or hindsight in deciding whether a claim is obvious. I further understand that a claim may be rendered obvious if a person of ordinary skill in the art can implement the claimed invention as a predictable variation of a known product. I also understand that a person of ordinary skill in the art is presumed to have knowledge of the relevant prior art at the time of the claimed invention, which comprises any prior art that was reasonably pertinent to the particular problems the inventor faced.

32. I understand that a showing of obviousness requires some articulated reasoning with a rational underpinning to support the combination of the references. I understand that in consideration of the issue of obviousness it is important to

identify whether a reason existed at the time of the invention that would have led a POSITA to combine elements of the references in a way that yields the claimed invention.

33. I understand that a claim may be considered unpatentable for obviousness for various reasons. I have been informed that the following exemplary rationales may support a finding of obviousness:

(A) combining prior art elements according to known methods to yield predictable results;

(B) simply substituting one known element for another to obtain predictable results;

(C) use of a known technique to improve similar devices in the same way;

(D) applying a known technique to a known device or method ready for improvement to yield predictable results;

(E) choosing from a finite number of identified, predictable solutions with a reasonable expectation of success;

(F) known work in a field that prompts variations in the work in the same or a different field that leads to predictable results; and

(G) some teaching, suggestion, or motivation in the prior art that would have led a person of ordinary skill in the art to modify a prior art reference or

combine multiple prior art references or teachings to arrive at the claimed invention.

34. I understand that various objective or "real world" factors, also referred to as secondary considerations, may be indicative of non-obviousness. I understand that such factors/considerations include:

(A) the commercial success of the claimed invention;

(B) the existence of a long-felt, unresolved need for a solution to the problem solved by the claimed invention;

(C) failed attempts to solve the problem solved by the claimed invention;

(D) copying of the claimed invention;

(E) unexpected results of the claimed invention;

(F) praise for the claimed invention by others in the relevant field; and

(G) willingness of others to accept a license under the patent because of the merits of the claimed invention.

35. It is my understanding that the prior art references themselves may provide a suggestion, motivation, or reason to combine, but other times the link may be common sense. I further understand that the obviousness analysis recognizes that market demand, rather than scientific literature, often drives innovation, and that is sufficient motivation to combine references.

36. It is my understanding that a particular combination may be proven obvious merely by showing that it was obvious to try the combination. For example, common sense is a good reason for a person of ordinary skill to pursue known options when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions.

37. I further understand that a proper obviousness analysis focuses on what was known or obvious to a person of ordinary skill in the art, not just the patentee. Accordingly, it is my understanding that any need or problem known in the field at the time of invention and addressed by the patent can provide a reason for combining the limitations in the manner claimed.

V. THE RELEVANT ART AND LEVEL OF ORDINARY SKILL IN THE RELEVANT ART

38. In my opinion, the relevant field of art for the ’682 patent is a method of operating a cable television network. Ex. 1101, Abstract, 1:49-52.

39. I understand that obviousness is determined from the vantage point of a hypothetical person having ordinary skill in the art (POSITA) at the time of the alleged invention, which, for purposes of this declaration, I have assumed is the earliest claimed priority date of July 23, 2012.

40. I understand that the following four factors may be considered when identifying the appropriate level of a POSITA: (i) the types of problems encountered by those working in the field and prior art solutions thereto; (ii) the sophistication of

the technology in question, and the rapidity with which innovations occur in the field; (iii) the educational level of active workers in the field; and (iv) the educational level of the inventor. I understand that a POSITA is one who is presumed to be aware of all pertinent art, thinks along conventional wisdom in the art, and is a person of ordinary creativity.

41. It is my opinion that, for the ’682 patent, a person of ordinary skill in the art (a "POSITA") at the time of the alleged invention would have had at least a degree in computer or electrical engineering, computer science, information systems, or a similar discipline, along with at least three-to-four years of experience with the design and/or implementation of network-based content delivery systems, such as video-on-demand cable systems and Internet video streaming.

42. I worked in the relevant field with persons meeting this definition of a POSITAA at, and leading up to, the time of the alleged invention of the ’682 patent (*i.e.*, July 23, 2012). Therefore, I am familiar with the knowledge and skills that would have been possessed by a hypothetical person of ordinary skill in the art at the time of the alleged invention. In addition, I believe that my extensive industry experience and educational background qualify me as an expert in the relevant field.

43. In this Declaration, wherever I refer to a POSITA, it should be understood that I am referring to a hypothetical person at the time of the alleged

invention of the ’682 patent (*i.e.*, July 23, 2012) meeting the description I have provided in this section.

VI. CLAIM CONSTRUCTION

44. I understand that all claim terms herein should be given their ordinary and customary meaning to a POSITA, consistent with the prosecution history. I understand that the Petitioner does not contend that the claims include any means-plus-function limitations.

VII. OVERVIEW OF THE ’682 PATENT

A. ’682 Patent

45. The ’682 patent relates to service group management in a cable television network. Ex. 1101, 1:50-52. “A cable modem termination system (CMTS) may determine, for a plurality of cable modems (CMs) served by the CMTS, a corresponding plurality of SNR-related metrics. The CMTS may assign the modems among a plurality of service groups based on the SNR-related metrics.” Ex. 1101, Abstract.

46. An exemplary process for grouping cable modems (CMs) in accordance with the alleged invention is shown in Figure 3A below.

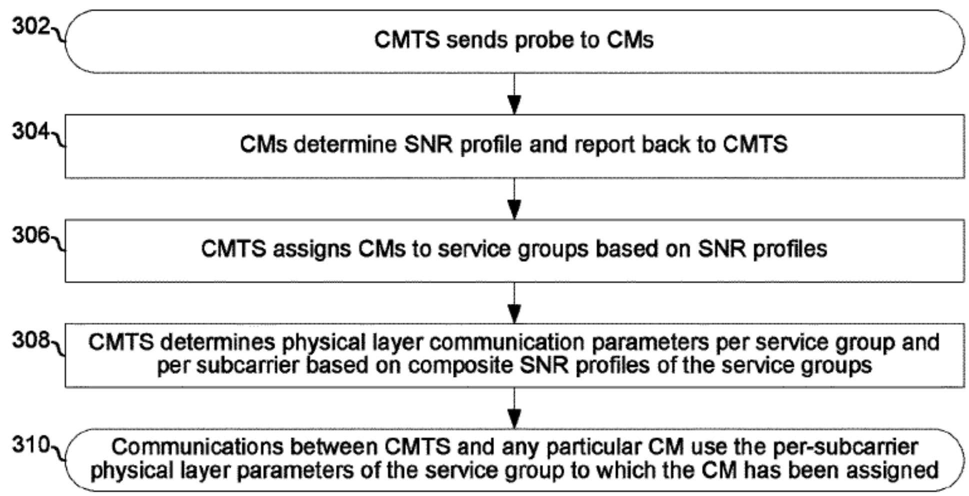


FIG. 3A

Ex. 1101, FIG. 3A

47. As illustrated, a plurality of cable modems each determine a signal-to-noise ratio (SNR) profile and report the profile back to a cable modem termination system (CMTS). Ex. 1101, 4:25-30, 5:34-37. The CMTS then assigns the cable modems to groups based on the SNR profiles. Ex. 1101, 4:52-56, 5:37-39, 6:46-7:6, Abstract. A composite SNR profile for each service group is used to determine a physical layer communication parameter used for communication between the CMTS and cable modems. Ex. 1101, 4:40-56, 5:40-50, Abstract. Physical layer communication parameters include encoding and modulation parameters, such as modulation type and modulation order. Ex. 1101, 4:56-67.

B. Prosecution History

48. The application that led to the ’682 patent, U.S. Application No. 15/866,106, was filed on January 9, 2018. Ex. 1104, 8-37, 52-54.

49. All claims were rejected in an Office Action dated April 3, 2018, on the ground of nonstatutory double patenting as being unpatentable over claims 1-18 of U.S. Patent No. 9,577,886 to Ling *et al*., claims 1-18 of U.S. Patent No. 9,419,858 to Ling *et al*. and claims 1-18 of U.S. Patent No. 9,866,438 to Ling *et al*. *Id*., 61-89. The Examiner also indicated that claims 1 and 10 contained allowable subject matter because the prior art failed to disclose or render obvious:

> "*... a composite SNR-related metric based <u>at least in part on a worst-case SNR profile of said SNR-related metrics</u> corresponding to said one of said plurality of service groups* … in combination with other limitations recited in the claims."

Id., 85 (emphasis in original).

50. The Applicant filed a Terminal Disclaimer on June 21, 2018 and the Examiner issued a Notice of Allowance on August 1, 2018. *Id*., 104, 122-123, 130-136.

51. The ’682 patent issued on November 20, 2018. Ex. 1101, cover.

C. Priority Date

52. I understand that the earliest possible priority date for the'682 patent claims is July 23, 2012, which is the filing date of U.S. Provisional Application No. 61/674,742.

VIII. TECHNICAL BACKGROUND

A. Orthogonal Frequency Division Multiplexing (OFDM)

53. OFDM is a modulation method for efficiently transmitting large amounts of data over a signal processing network. Ex. 1124, ¶2. The bandwidth (channel), reserved for data traffic, is divided into multiple and narrower sub-bands (sub-channels). Ex. 1124, ¶2. The data is also divided into lower data rate channels, each encoded on different subcarrier frequencies for transmission over the network. Ex. 1124, ¶2. The subcarrier frequencies are mutually orthogonal so that the frequencies are simultaneously transported to and accurately retrieved at the receiver. Ex. 1124, ¶2. The subcarriers maintain orthogonality by being spaced at frequency intervals 1/T, where T represents the OFDM symbol period. Ex. 1124, ¶2. This approach reduces intersymbol interferences (ISI) by extending the symbol duration relative to the channel's delay spread. Ex. 1124, ¶¶2, 5.

54. In OFDM, the data bits are grouped as symbols based on the number of bits per symbol. The group of symbols are them modulated by the inverse Fourier transform. The OFDM output signal is generated by calculating an Inverse Fast Fourier Transform (IFFT) on a set of symbols. Ex. 1124, ¶3. Each symbol of the

set of symbols defining the OFDM symbol represents a specific plurality of data bits and may be retrieved by performing the Fourier transform on the OFDM symbol. Ex. 1124, ¶3. In this way, only one symbol will be generated for any subcarrier frequency. Ex. 1124, ¶3. Further, because transmitted data is divided over multiple carrier sub-bands (sub-channels), the symbol intervals become longer, proportional to the number of sub-bands, than if transmitting data over a single band (channel). Ex. 1124, ¶5. Longer symbol intervals reduce ISI when the symbol period overtakes the channel spread, as any ISI is then spread over fewer symbols. Ex. 1124, ¶5.

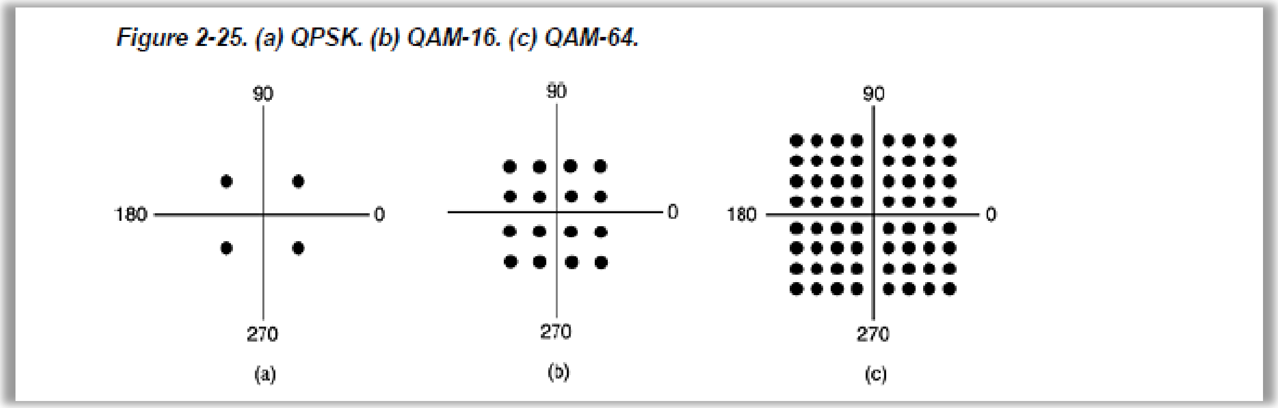
55. Similarly, OFDMA (Orthogonal Frequency-Division Multiple Access) transmits data over several sub-bands with different carrier frequencies. Ex. 1124, ¶¶60, 90-91. With OFDMA, multiple users are assigned a subset of subcarriers that are orthogonal to each other. Ex. 1124, ¶¶60, 90-91.

B. Quadrature Amplitude Modulation (QAM)

56. Transmitting data over a cable network requires encoding the data onto a carrier wave by modulation. Ex. 1125, Abstract, 1:10-43; Ex. 1126, 89-90, 98-101. Modulation entails changing the carrier wave's amplitude, frequency, and/or phase according to the desired transmitted data. Ex. 1126, 98-99. After transmitting the encoded carrier wave over the network, the data is extracted from the carrier wave by demodulation at the receiver. Ex. 1125, 1:44-53; Ex. 1126, 89-90. One

modulation technique is called Quadrature Amplitude Modulation (QAM). Ex. 1125, 1:10-43.

57. QAM employs two carrier signals within the same frequency band that are orthogonal to each other. Ex. 1125, 1:10-43. The two carrier signals are called an in-phase signal (I) and quadrature signal (Q). Ex. 1125, 1:10-43. The carrier signals are modulated and then combined for network transmission. Ex. 1125, 1:10-43. During modulation, the data bits are divided into groups called symbols. Ex. 1126, 98-99. For example, in 16-QAM, each symbol represents four bits. Ex. 1126, 98-99. As each bit is either a zero or a one, grouping four bits together results in 16 combinations of zeros and ones (*e.g.*, 0001, 0011, 0111, 1111, 1000, 1001, etc.). Ex. 1126, 98-99. Each group is represented by a symbol encoded on the carrier wave with a unique amplitude and phase shift modulation. Ex. 1126, 98-99. Constellation diagrams map all the possible modulation options to each of the 16 symbols within the particular modulation scheme, which includes both modulation type and modulation order, as shown below. Ex. 1126, 98-99.



Ex. 1126, FIG. 2-25.

58. Each point in the constellation diagram represents a unique amplitude and phase used to encode the signal onto the carrier wave. Ex. 1126, 98-99. During demodulation, each symbol's amplitude and modulation are detected and looked up on the constellation diagram, resulting in decoding the original bits. Ex. 1126, 98-99; Ex. 1125, 5:10-33. A timing feature is employed to determine the start of each new symbol. Ex. 1125, 1:25-55.

C. Quadrature Phase Shift Keying (QPSK)

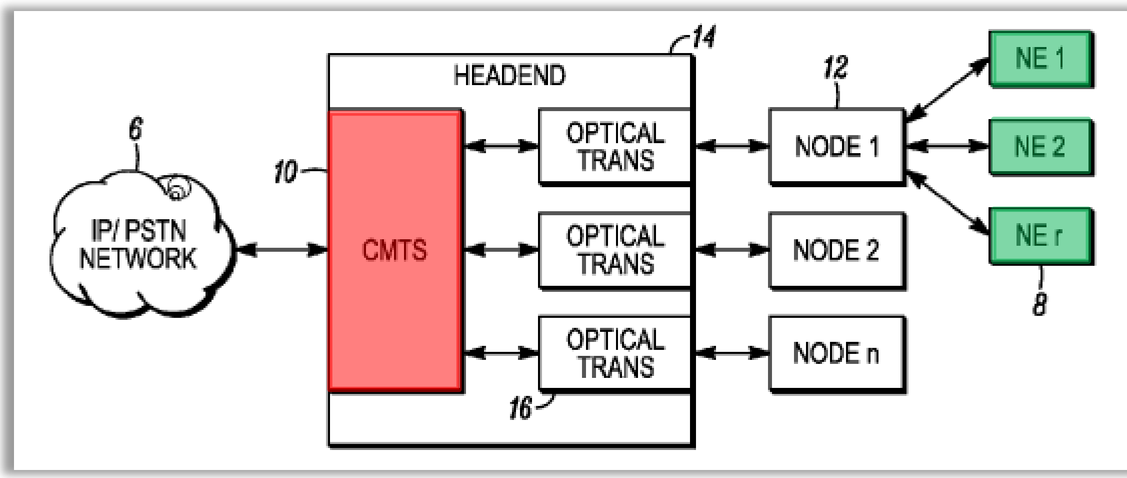
59. QPSK is another modulation technique. Ex. 1127, 64, 79, 237. Like QAM, QPSK employs two identical carrier signal waves orthogonal to each other. Ex. 1127, 237. However, QPSK modulation employs four different points in the constellation diagram, as indicated above. Ex. 1126, FIG. 2-25. Therefore, each symbol modulated using QPSK represents two bites of data. Ex. 1127, 237. QPSK effectively doubles the bandwidth of the network and allows for efficient use of the frequency spectrum. Ex. 1127, 237.

IX. OVERVIEW OF THE PRIOR ART

A. Thibeault

60. Thibeault (Ex. 1110) is a U.S. Published Application filed August 11, 2011. Thibeault is prior art under pre-AIA 35 U.S.C. § 102(e) and was not considered during prosecution. Ex. 1101, cover.

61. Thibeault discloses a network having multiple network elements 8 (**green**) that connect to a CMTS 10 (**red**) via nodes 12. Ex. 1110, ¶25, FIG. 1. Thibeault's network elements 8 include cable modems (hereinafter "CMs") via nodes 12. Ex. 1110, ¶¶25, 37.



Ex. 1110, FIG. 1 (annotated)

62. Thibeault explains that CMTS 10 resides at a headend 14, which includes transceivers 16 that communicate with the network elements by receiving upstream communications from the network elements and sending (*i.e.*, serving) downstream communications to network elements. Ex. 1110, ¶25. Thibeault discloses optimizing network communications based on certain network parameter

measurements—measurements that can be performed at the CMTS or each CM. Ex. 1110, ¶¶13, 31, 39.

63. Thibeault discloses a process whereby its CMTS measures network parameters for the cable modems connected to the CMTS. Ex. 1110, ¶¶24, 32, 37. The network element parameters may include respective signal to noise ratios (SNRs) of each cable modem. Ex. 1110, ¶¶9, 11, 15, 23, 32, 37.

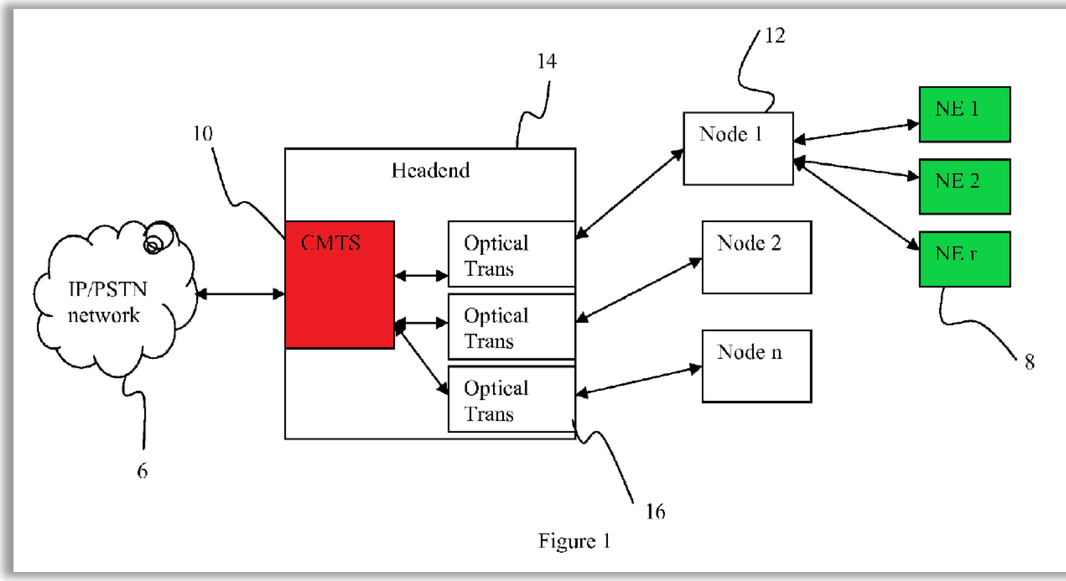
64. Thibeault's method is directed toward "assign[ing] [a] network element to a logical channel based on the network element parameters." Ex. 1110, ¶8. Specifically, Thibeault teaches that its method includes "differentiat[ing] cable modems by [SNR], set[ting] up multiple logical channels, each one with a different modulation rate, and then assign[ing] the appropriate network elements to each logical channel based upon which modulation could be supported" based on the respective SNR of each CM. Ex. 1110, ¶24; *see also id.*, ¶¶8, 11, 23.

B. Cooper

65. Cooper (Ex. 1105) is a U.S. Published Application published September 27, 2007. Cooper is prior art under pre-AIA 35 U.S.C. § 102(b) and was not considered during prosecution. Ex. 1101, 1-2.

66. Cooper describes a "process for reconfiguring logical channels" in a network. Ex. 1105, ¶¶2, 17, 30-31. As illustrated below in Figure 1, Cooper

discloses a network in which multiple network elements 8 such as cable modems (**green**) connect to a CMTS 10 (**red**) via nodes 12. Ex. 1105, ¶22, FIG. 1.



Ex. 1105, FIG. 1 (annotated)

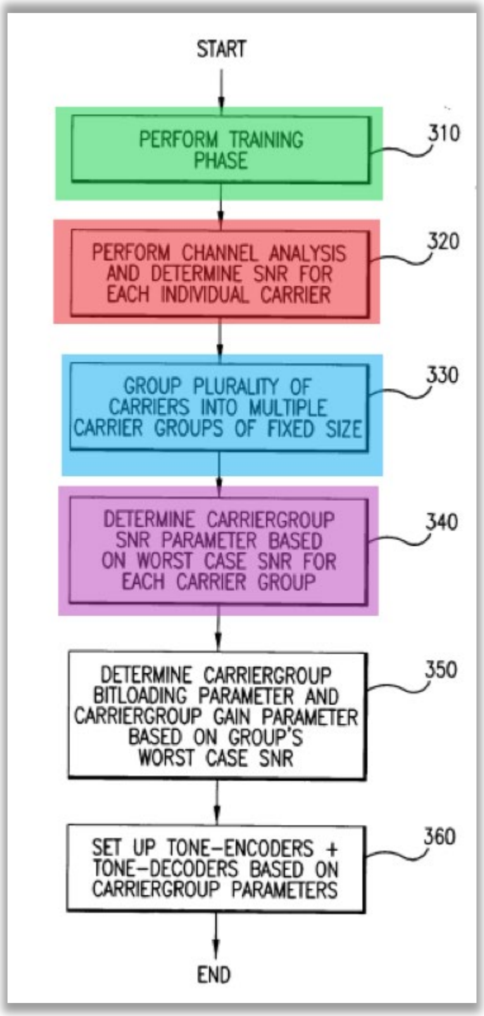
67. Cooper explains that CMTS 10 resides at a headend 14, which includes transceivers that communicate with the network elements by receiving upstream communications from the network elements and sending downstream communications to the network elements. Ex. 1105, ¶22; *see id.*, ¶3. The measured network parameters are determined in cooperation with the network elements without interruption of active communication services. The network parameters include upstream or downstream modulation error ratio (MER), upstream or downstream signal to noise ratio (SNR), upstream or downstream microreflections, upstream transmit level, downstream receive power level. Ex. 1105, Abstract. Cooper further describes a process that allows a network operator to easily group

cable modems based upon common parametrics and performance similarities. Ex. 1105, ¶19. Cooper's groupings of cable modems may then be used to configure logical channels and subsequently the assignment of cable modems to logical channels. Ex. 1105, ¶19.

C. Saey

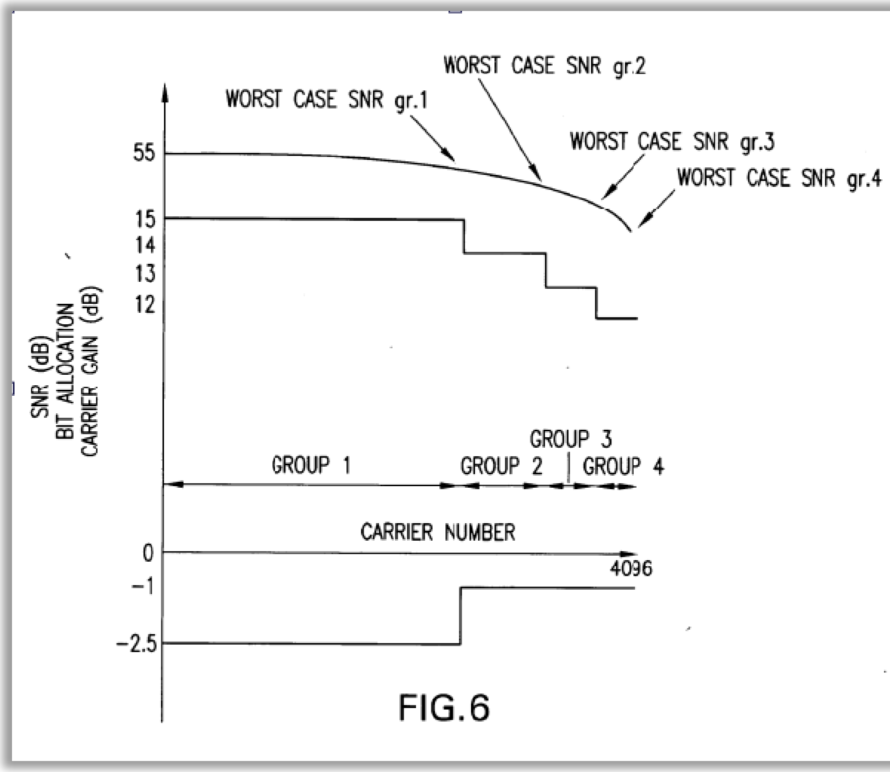
68. Saey (Ex. 1107) is a U.S. Published Application published May 26, 2005. Saey is prior art under pre-AIA 35 U.S.C. § 102(b) and was not considered during prosecution. Ex. 1101, 1-2.

69. Saey describes a method and system of grouping one or multiple carrier groups based at least in part on a worst-case SNR. Ex. 1107, Abstract, ¶10. In one embodiment, a training phase 310 (**green**) is performed. Modems negotiate about parameters to be used. Ex. 1107, ¶29. A channel analysis step 320 (**red**) determines an SNR for each individual carrier. Ex. 1107, ¶30. At step 330, the plurality of carriers is grouped into multiple carrier groups of fixed size (**blue**). Ex. 1107, ¶31. At step 340 (**purple**), the worst-case SNR for each fixed size carrier group is determined and used to define a "carriergroup SNR parameter" for that specific carrier group. Ex. 1107, ¶32.



Ex. 1107, FIG. 3 (annotated)

70. Figure 6 also illustrates the SNR for each of the individual carriers as a continuous curve. The worst-case SNR for each group is determined and used to calculate the worst-case bit loading and the worst case carrier gain for each group. Thus, each carrier group has a carrier group SNR parameter based on the worst-case SNR for the carriers in the group, a carrier group bitloading parameter and a carrier group gain parameter based on the worst-case carrier group SNR parameter for that particular group. Ex. 1107, ¶43.



Ex. 1107, FIG. 6.

D. Gross

71. Gross (Ex. 1108) is a U.S. Published Application published May 6, 2004. Gross is prior art under pre-AIA 35 U.S.C. § 102(b) and was not considered during prosecution. Ex. 1101, 1-2.

72. Gross describes enhancing the accuracy and reliability of communications in systems using discrete multitone technology to communicate data over digital subscriber lines. Ex. 1108, ¶24. Gross uses special data modems that carry voice and data communications simultaneously and can operate without special filtering provided by "plain old telephone service" (POTS) splitters. Ex. 1108, ¶25. In the event there is a disturbance on the communication channel, the

modem changes the bit allocation and the subchannel gains among the subchannels. Ex. 1108, ¶25. Channel control parameter sets are used to achieve this goal. Ex. 1108, ¶30. A key parameter used is known as the "bit allocation" for respective subchannels and is calculated based on the channel SNR. Ex. 1108, ¶32. Gross describes parameter sets representing a "worst case" condition which would be based at least in part on a worst-case SNR. Ex. 1108, ¶100.

E. Cioffi

73. Cioffi (Ex. 1109) is a U.S. Published Application published December 7, 2006. Calvert is prior art under pre-AIA 35 U.S.C. § 102(b) and was not considered during prosecution. Ex. 1101, 1-2.

74. Cioffi describes digital data transmission and/or communications systems that utilizes methods and systems that mitigate or remove interference signals among users with interconnected transmitters. Ex. 1109, ¶12. Cioffi uses precoding to mitigate or remove interference signals. Ex. 1109, Abstract. Precoding implementation uses matrix channel H to model the channel from users' transmitters to their receivers. Ex. 1109, ¶13. The channel H may be decomposed into matrices R and Q. Ex. 1109, ¶13. R and Q can be updated when changes occur to the transmission environment. Ex. 1109, Abstract. The SNR of a user is proportional to a certain coefficient within the H matrix channel. Ex. 1109, ¶14. In certain embodiments, matrix R is chosen to represent the worst-case noise for the channel

and the equivalent H matrix is often referred to as the worst-case-noise equivalent channel matrix. Ex. 1109, ¶¶63-64.

F. Cooper-437

75. Cooper-437 (Ex. 1116) is a U.S. Patent filed July 28, 1999 and granted on August 3, 2004. Cooper-437 is prior art under pre-AIA U.S.C. § 102(b) and was not considered during prosecution. Ex. 1101, 1-2.

76. Cooper-437 discloses a method by which a CMTS requests and receives specific noise signal power measurements from cable modems in its network. Ex. 1116, Abstract, 1:62-65, 3:47-50, FIG. 1. For example, Cooper-437 describes a CMTS initiating noise signal power measurements by transmitting to cable modems in the network a message that defines the measurement techniques to be used and how to report the measurements. Ex. 1116, 8:11-29, 8:60-9:5, 10:56-11:28, Table 1.

77. Cooper further discloses that, after a cable modem receives the message, the cable modem performs the noise signal power measurements specified in the message, and then sends a report of the measurements (which may be provided as raw measured data) to the CMTS. Ex. 1116, 10:56-11:28, Table 1.

G. Monk

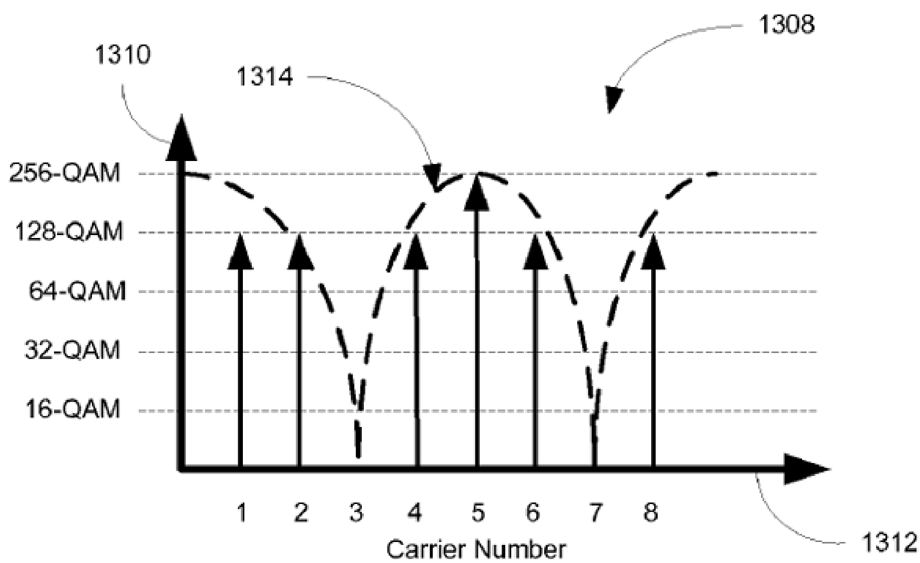
78. Monk (Ex. 1115) is a U.S. Patent filed November 12, 2007 and granted on August 11, 2009. Monk is prior art under pre-AIA 35 U.S.C. § 102(b) and was not considered during prosecution. Ex. 1101, 1-2.

79. Monk discloses a method of communication that relies on different modulation schemes based on a communication channel's SNR. Ex. 1115, Abstract, 4:25-38, 6:6-19, 7:14-31, 8:1-11. For example, Monk teaches that higher SNR channels can support higher modulation orders through bit loading (*e.g.*, 16-QAM, 64-QAM and 256-QAM), while lower SNR channels may use a different modulation scheme such as QPSK. Ex. 1115, 4:55-59, 8:1-11, 9:9-11, 10:58-62. To determine the SNR of a channel, Monk discloses a sending node transmitting a probe message having a predetermined data sequence to a receiving device, which then analyzes the probe message for impairment at each frequency. Ex. 1115, 4:44-59, 9:28-41, Abstract. Monk further discloses that the receiving device then sends the results of the analysis back to the sending device, as either raw data or a bit loading profile for the sending device to modify the transmission parameters. Ex. 1115, 9:42-50.

H. Monk-802

80. Monk-802 (Ex. 1114) is a U.S. Patent filed December 2, 2005, and granted on December 27, 2011. Monk-802 is prior art under pre-AIA U.S.C. § 102(e) and was not considered during prosecution. Ex. 1101, 1-2.

81. Monk-802 discloses a method of communication using OFDM. Ex. 1114, 8:1-39, 17:61-67, 19:27-41, 21:19-22:34, FIGS. 12, 13A-C. Specifically, Monk-802 discloses dividing a waveform into multiple sub-carriers, each of which is independent and can be modulated on a per-subcarrier basis depending on the channel's SNR, with higher SNR channels supporting higher data capacity or modulation schemes. Ex. 1114, 8:19-39, 21:19-22:34. Monk-802's Figure 13B included below, for example, shows the frequency profile of a carrier frequency with eight sub-carriers, each with different QAM orders (*e.g.*, 16, 32, 64, 128, 256) based on the frequency response of each sub-carrier, which corresponds to that subcarrier's SNR. Ex. 1114, 21:53-22:16, FIGS. 13A-13C; *see also* Ex. 1114, 8:19-25, 20:59-21:43.



Ex. 1114, FIG. 13B

82. Monk-802 explains that OFDM helps cable broadband coaxial networks overcome signal impairments caused by issues such as multipath reflects

in a highly dispersive environment (*e.g.*, an in-house coaxial network). Ex. 1114, 4:7-24, 8:8-25.

X. OPINIONS WITH RESPECT TO THE '682 PATENT

A. Thibeault in View of Saey Renders Claims 1-2 and 10-11 Obvious

1. Independent Claim 1

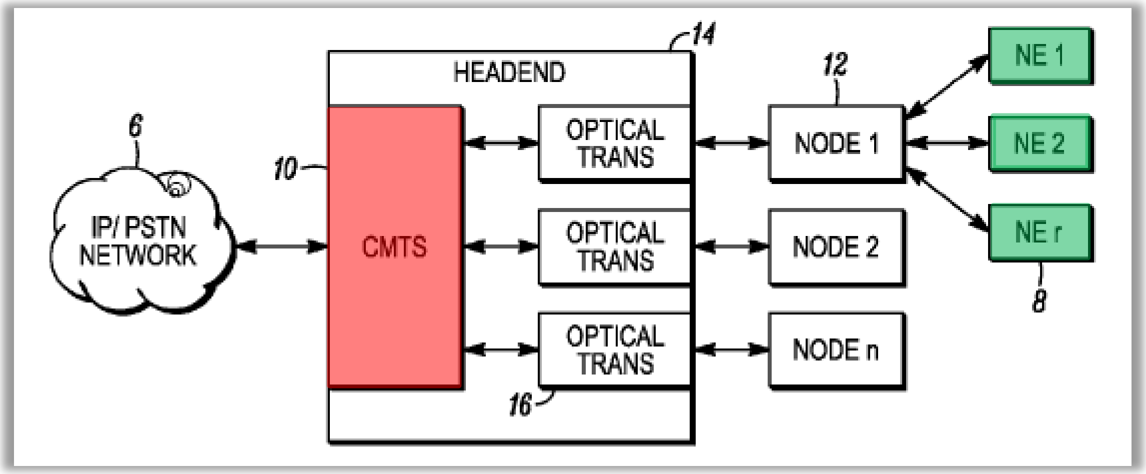
83. Below I demonstrate that independent claim 1 is obvious. Independent claim 10 is a counterpart system claim. Therefore, it is rendered obvious for the same reasons as I describe for independent claim 1 below.

a. Element [1A]: "A method comprising:"

84. If Element [1A] is limiting, then it is disclosed by Thibeault. Specifically, Thibeault discloses a method performed by a CMTS for automatically configuring logical channels to communicate with cable modems in a network. Ex. 1110, Abstract, ¶¶4, 9-15, 21, 32-33.

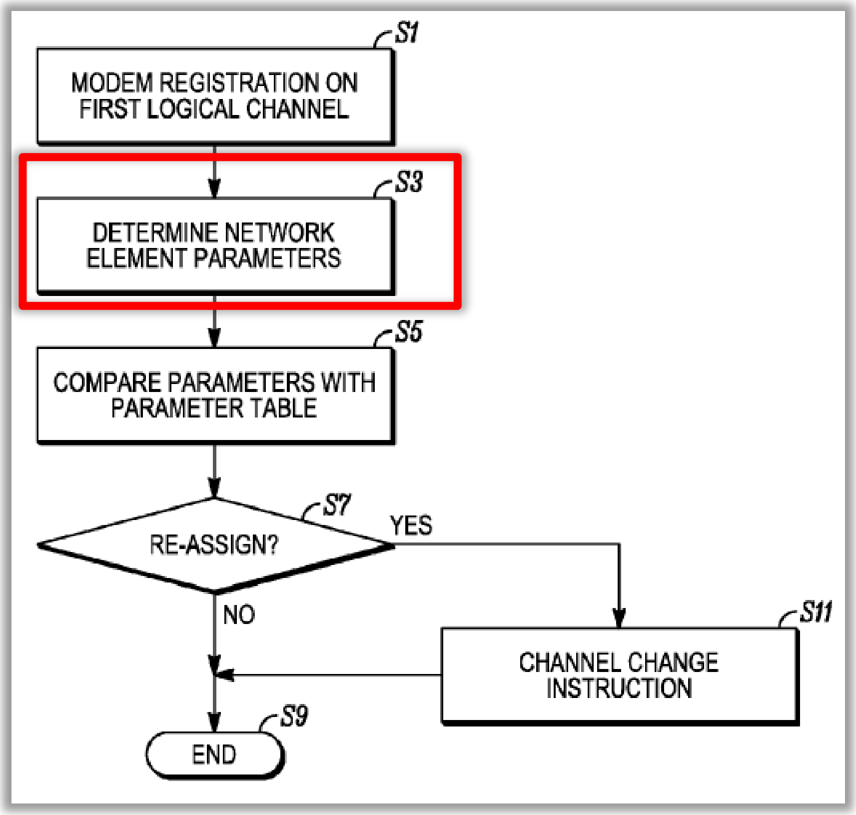
b. Element [1B]: "determining, by a cable modem termination system (CMTS), for each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;"

85. Thibeault discloses Element [1B]. As I show below in Thibeault's Figure 1, Thibeault discloses a network having multiple network elements 8 (**green**) that connect to a CMTS 10 (**red**) (the claimed "CMTS") via nodes 12. Ex. 1110, ¶25, FIG. 1. Thibeault's network elements 8 include cable modems. Ex. 1110, ¶¶25, 37.



Ex. 1110, FIG. 1 (annotated)

86. Thibeault explains that CMTS 10 resides at a headend 14, which includes transceivers 16 that communicate with the network elements by receiving upstream communications from the network elements and sending (i.e., serving) downstream communications to network elements (the claimed "each cable modem served by said CMTS"). Ex. 1110, ¶25. Thibeault discloses optimizing network communications based on certain network parameter measurements—measurements that can be performed at the CMTS or each CM. Ex. 1110, ¶¶13, 31, 39. With reference to Figure 4 below, for example, Thibeault discloses a process whereby its CMTS measures network parameters for the cable modems connected to the CMTS. Ex. 1110, ¶¶24, 32, 37. The network element parameters may include respective signal to noise ratios (SNRs) of each cable modem (the claimed "determining … a corresponding [SNR] related metric."). Ex. 1110, ¶¶9, 11, 15, 23, 32, 37.



Ex. 1110, FIG. 4 (annotated)

87. Thibeault thus discloses determining the SNR for each cable modem served by a CMTS.

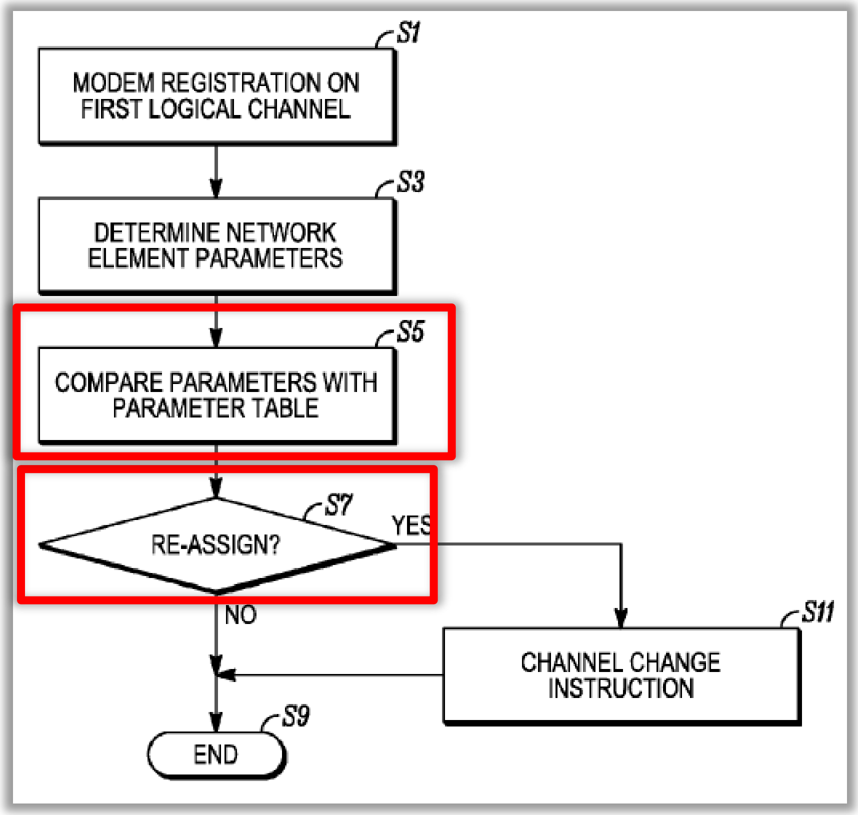
88. Therefore, Thibeault discloses Element [1B].

c. Element [1C]: "assigning, by said CMTS, each cable modem among a plurality of service groups based on a respective corresponding SNR-related metric;"

89. Thibeault discloses Element [1C]. Thibeault's method is directed toward "assign[ing] [a] network element to a logical channel based on the network element parameters." Ex. 1110, ¶8. Specifically, Thibeault teaches that its method includes "differentiat[ing] cable modems by [SNR], set[ting] up multiple logical

channels, each one with a different modulation rate, and then assign[ing] the appropriate network elements to each logical channel based upon which modulation could be supported" based on the respective SNR of each CM. Ex. 1110, ¶24; *see also id*., ¶¶8, 11, 23.

90. In Figure 4, for example, Thibeault illustrates this process of grouping its cable modems by assigning them to respective logical channels. Ex. 1110, ¶¶32-33, FIG. 4. As I show below, after determining the network parameters (*e.g*., SNR), Thibeault's CMTS assigns the cable modems to logical channels based on a comparison between their measured network parameters and parameter thresholds (*e.g*., SNR thresholds). Ex. 1110, ¶¶32 ("As shown in step S5, the network element parameters are compared against a parameter table containing a table of one or more parameter thresholds associated with a logical channel available on the network to determine if the CMTS needs to reassign that modem to a different logical channel on the currently used physical upstream port."), 33; *see* Section X.A.1.b, *supra*.



Ex. 1110, FIG. 4 (annotated)

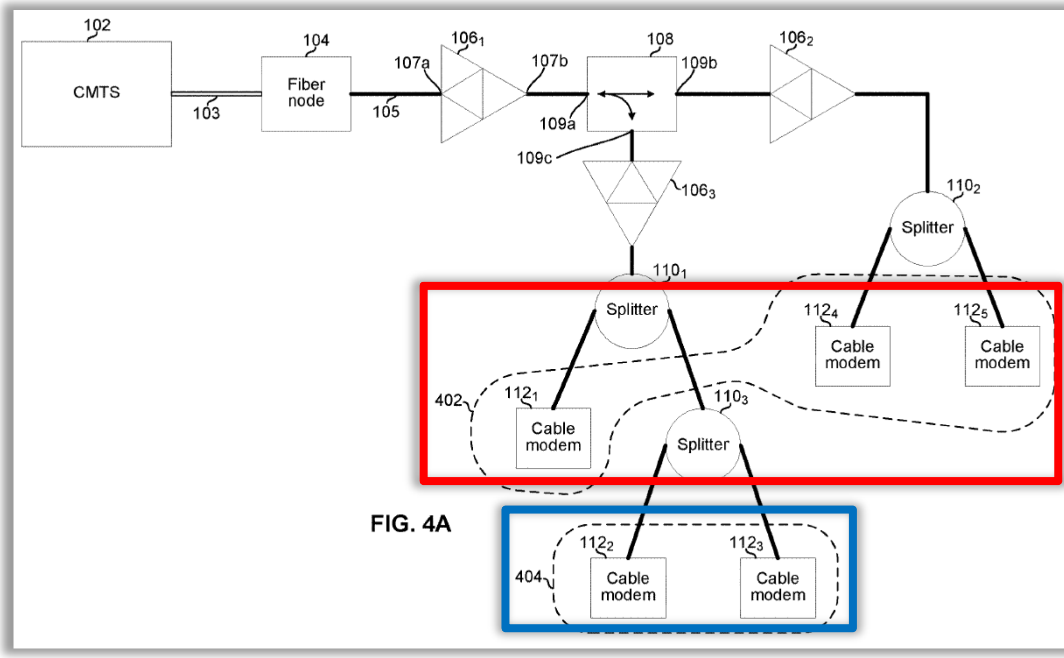
91. In one specific example, Thibeault's CMTS assigns the connected cable modems to one of four logical channels based on comparing the respective SNR measurements of each cable modem to SNR thresholds, *i.e.*, (1) a group with measured SNRs between 16 and 22 is assigned to logical channel "0"; (2) a group with measured SNRs between 22 and 25 is assigned to logical channel "1"; (3) a group with measured SNRs between 25 and 28 is assigned to logical channel "2"; and (4) a group with measured SNRs above 28 is assigned to logical channel "3." Ex. 1110, ¶33. The network element parameters may include a modulation error

ratio (MER) or a signal to noise ratio (SNR). The Modulation error ratio (MER) is the ratio, of average signal symbol power to average error power.

$$MER(dB) = 10\log(\frac{average\ signal\ power}{average\ error\ power})$$

The signal to noise ratio is the average signal power in channel in a given bandwidth over the noise within that bandwidth. SNR is related to MER, as if the channel noise increases, the bit-error rate (BER), symbol error rare (SER), and MER will increase. If the noise in the channel increases, the BER, SER, and MER will increase. MER is affected by many factors in the digitally modulated signal's transmission path including SNR, transmitted phase noise, carrier-to-noise ratio (CNR); nonlinear distortions etc.

92. Each group of CMs assigned to a logical channel is a claimed "service group", and there are a "plurality of such groups" in Thibeault. This is consistent with term's plaining meaning and the '682 patent's disclosure. The '682 patent, for example, illustrates service groups in Figure 4A as I show below where the groupings are based on performance characteristics measured for the cable modems. Ex. 1101, 2:24-27, 5:37-39, 6:42-61, FIGS. 3A, 4A.



Ex. 1101, FIG. 4A (service group 402 includes cable modems **112_1, 112_4, 112_5**; service group 404 includes cable modems **112_2, 112_3**) (annotated)

93. The assignment by Thibeault's CMTS (the claimed "assigning, by said CMTS,") of each cable modem (the claimed "each cable modem") to a particular logical channel based on its SNR measurement (the claimed "based on a respective corresponding SNR-related metric") thus results in groups of assigned cable modems that are grouped by logical channel (the claimed "assigning … among a plurality of service groups"), which is consistent with the '682 patent's disclosure regarding service groups.

94. Therefore, Thibeault discloses Element [1C].

d. Element [1D]: "generating, by said CMTS for each one of said plurality of service groups, a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics

corresponding to said one of said plurality of service groups;"

95. Thibeault-Saey discloses Element [1D]. As I show above for Element [1C], Thibeault discloses assigning cable modems to logical channels based on a comparison between the determined SNR for each cable modem and SNR thresholds. Sections X.A.1.b-c, *supra*; Ex. 1110, ¶¶9, 11, 15, 23, 32, 37, FIG. 4. Although Thibeault does not disclose determining a "worse-case" SNR for each group of cable modems in each logical channel, a POSITA would have found it obvious to do so in view of Saey's teachings.

96. Saey teaches a method of grouping the various carriers that communicate with various CMs based on a network parameter (*e.g.*, SNR) in a communication system between CMs. Ex. 1107, Abstract, ¶¶9-14. Saey, for example, discloses analyzing the SNR for individual carriers and determining a carrier group based on this analysis. Ex. 1107, ¶¶25-26, 29-31, 42-43, FIGS. 3, 5-6. After the carriers have been sorted into groups, the worst-case SNR (*e.g.*, the lowest SNR) in the group is used as the carrier group SNR parameter. Ex. 1107, ¶¶10, 13-14, 25-27, 32, 42-43, FIGS. 3, 5-6. This worst-case SNR is then used to determine the gain and bit loading (the quantity of bits that can be loaded onto each carrier) for communicating with the modems associated with the carrier group. Ex. 1107, ¶¶4, 27, 33, 43, FIGS. 3, 5-6.

97. A POSITA would have recognized that bit loading "is applied to increase the modulation order at carriers with high signal to noise ratio and lower the modulation order at carriers with low [SNR]." Ex. 1115, 4:55-59, 8:1-19. A carrier's SNR, for example, impacts the bit loading of the carrier, and thus the carrier's modulation (*e.g.*, 2 bits per symbol (bps) for QPSK, 4 bps for 16QAM, 5 bps for 32QAM). Ex. 1115, 4:55-59, 8:1-19, 9:9-11, 10:55-67, FIG. 10; Ex. 1112, 14:54-16:34; Section X.A.1.e, *infra* Saey's method of grouping carriers and determining a single parameter for the group allows the system to take advantage of similarity between carriers, which conserves system resources (*e.g.*, memory, transmission costs) while ensuring communication with all cable modems within a group. Ex. 1107, ¶¶14, 27.

98. A POSITA would have found it obvious to apply Saey's teaching of determining the worst-case SNR for each cable modem group to Thibeault's selection of an optimal physical layer communication parameter (*e.g.*, modulation order) in order to take advantage of similarity between different carriers communicating within a channel, which conserves system resources (*e.g.*, memory, transmission costs) and ensures communication with all cable modems in a group. Ex. 1107, ¶¶14, 27. Thibeault's CMTS already assigns cable modems to logical channels based on a comparison of a cable modem's SNR measurement with SNR thresholds, which also determines the modulation mode (*e.g.*, modulation order) that

is used for communicating within the logical channel. Ex. 1110, ¶¶4-5, 15-16, 23-24, 29-30, 33, 38. Applying Saey's teaching of generating a worst-case SNR-profile for a carrier group would ensure communication with all cable modems in the group while also furthering Thibeault's goal of ensuring that "each network element [is] running at its best possible modulation mode." Ex. 1110, ¶¶38, 33; Ex. 1107, ¶¶4-5, 27, 33, 43, FIGS. 3, 5-6. Specifically, a POSITA would have appreciated that selecting a modulation order (*e.g.*, 16QAM, 32QAM/, 64QAM, etc.) for a logical channel based on the worst-case SNR of a cable modem group would have ensured communication with all cable modems in the group while also optimizing the network as described above.

99. A POSITA would have also found it obvious to apply Saey's teaching of determining the worst-case SNR for each cable modem group to implement Thibeault's dynamic SNR thresholds based on measured network parameters. Ex. 1110, ¶32. Specifically, Thibeault discloses that its CMTS automates periodically rerunning its logical channel configuration, including measuring parameters such as SNR for its cable modems, assigning (re-registering) cable modems to the logical channels, and setting thresholds (*e.g.*, SNR thresholds) used to delineate the logical channels. Ex. 1110, ¶¶16, 32-33, 38, FIGS. 4-5. A POSITA, therefore, would have an additional motivation to apply Saey's teaching of generating a worst-case SNR-

profile for a carrier group in order to implement Thibeault's dynamic SNR threshold to address variance in a channel's SNR. Ex. 1107, ¶¶10, 13-14, 25-27, 32, 42-43.

100. This combination of Thibeault and Saey also would have been obvious because it would have been the mere combination of prior art elements according to known methods to yield predictable results. The prior art elements include Thibeault's CMTS that applies modulation order parameters to CMs that are grouped based on a comparison of the CMs SNR characteristics and SNR thresholds, and Saey's method of determining a worst-case SNR for a group of CMs also grouped based on their individual SNRs to determine which physical layer parameters to apply to the group. The known methods include programming of a CMTS. The predictable results include a CMTS that that generates a worst-case SNR metric for the CM service group and uses that metric to determine the modulation order applied to the group and update the SNR threshold for the logical channel. Applying Saey's teachings to Thibeault's CMTS would have been well within the capabilities of a POSITA because it would have involved only minor modifications to the programming of Thibeault's CMTS. Ex. 1110, ¶¶8-9, 26-27, 39; Ex. 1107, ¶23.

101. Thibeault-Saey's teaching of the claimed "composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics" by selecting the worst-case or lowest SNR of the cable modems in a group

to generate that group's composite SNR is consistent with the term's plain meaning, a construction from a District Court litigation, and the '682 patent's disclosure. For example, the '682 patent discloses that a worst-case SNR profile simply includes multiple performance metric measurements (*e.g*., SNR) for the cable modems of a particular service group. Ex. 1101, 4:9-20, FIG. 2B. The '682 patent also teaches that physical layer parameters are determined based on the singular worst-case SNR for a service group. Ex. 1101, 5:40-46. I also understand that, in prior litigation, a District Court construed this phrase as having its plain meaning based on the '682 patent's disclosure. Ex. 1117, 53-55 (citing the '682 patent at 4:9-20, 5:7-12, 5:42-57, FIG. 2C); *see also id.,* 54 (noting Patent Owner's position that "'composite' means that something is **for** more than one cable modem" and that a POSITA "would understand that the term 'composite SNR-related metric' **relates to** multiple cable modems") (emphasis added); Ex. 1118, ¶187 (Patent Owner's expert explaining that the '682 patent's "specification describes that examples of a 'worst-case SNR profile' is the SNR profile related to a cable modem or group of cable modems, indicating their worst-case performance metrics" and citing the '682 patent at 4:9-20, 5:7-12, FIG. 2C); Ex. 1119, 8-10 (Patent Owner's infringement contentions alleging infringement of the claimed "composite SNR-related metric" based on a "worst case noise that is expected on" upstream and downstream channels).

102. Therefore, Thibeault-Saey teaches Element [1D].

e. Element [1E]: "selecting, by said CMTS, one or more physical layer communication parameter to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and"

103. Thibeault-Saey discloses Element [1E]. As I show above for Element [1D], Thibeault-Saey's CMTS generates a composite SNR for each logical channel based on the worst-case SNR of a cable modem assigned to that logical channel. Section X.A.1.d, *supra*. This composite SNR advantageously allows Thibeault-Saey's CMTS to select an optimal modulation order for communicating with the cable modems assigned to each logical channel (the claimed "plurality of service groups"). Section X.A.1.d, *supra*; Ex. 1110, ¶¶4-5, 15-16, 21, 23-24, 32-33, 38. For example, Thibeault discloses the CMTS periodically updating its SNR thresholds based on measured parameters (*i.e.*, Thibeault-Saey's composite SNR-related metrics), which define the logical channels that the CMTS selects a modulation order based on the updated threshold. Ex. 1110, ¶¶4-5, 15-16, 21, 23-24, 32-33, 38. The modulation order (*e.g.*, 16QAM, 32QAM, 64QAM) selected by Thibeault-Saey's CMTS for the logical channels discloses the claimed "one or more physical layer communication parameter to be used for communicating with said one of said plurality of service groups." Ex. 1101, Abstract, 4:56-57, 5:40-46.

104. Thibeault-Saey's CMTS thus teaches "selecting … one or more physical layer communication parameters [(*i.e.*, the modulation order)] to be used

for communicating with said one of said plurality of service groups based on said composite SNR-related metric" as claimed.

105. Therefore, Thibeault-Saey teaches Element [1E].

f. Element [1F]: "communicating, by said CMTS, with one or more cable modems corresponding to said one of said plurality of service groups using said selected one or more physical layer communication parameter."

106. Thibeault-Saey teaches Element [1F]. As I show above for Elements [1D]-[1E], Thibeault-Saey's CMTS selects the modulation order for the modulation profiles assigned to its logical channels based on the worst-case SNRs respectively determined for the cable modem groupings assigned to those logical channels. Ex. 1110, ¶33; *see also* Sections X.A.1.d-e, *supra*. Thibeault-Saey's CMTS also communicates with the cable modems connected to it using the selected modulation order (*e.g.*, 16QAM, 32QAM, 64QAM). Ex. 1110, ¶¶16, 24, 29-30, 33.

107. Thibeault-Saey thus teaches "communicating, by said CMTS, with one or more cable modems corresponding to said one of said plurality of service groups using said selected one or more physical layer communication parameter" as claimed.

108. Therefore, Thibeault-Saey teaches Element [1F].

2. Dependent Claim 2: "The method of claim 1, wherein said one or more physical layer communication parameter includes one or more of: transmit power, receive sensitivity, timeslot

duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate."

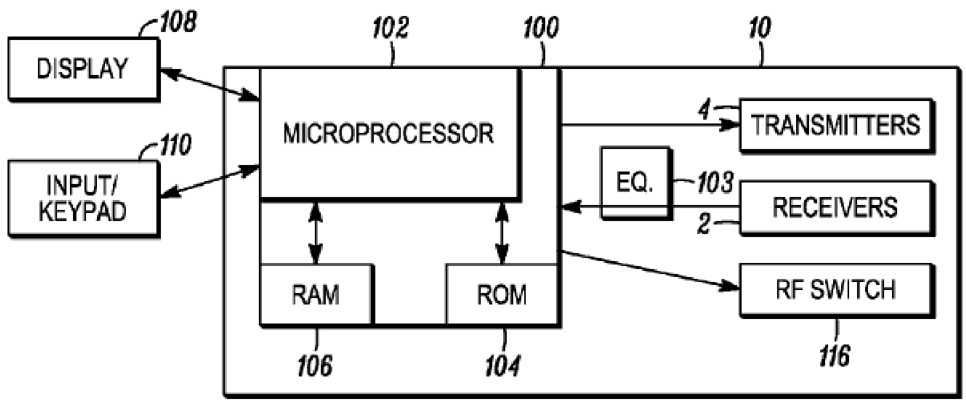
109. Thibeault-Saey teaches dependent claim 2. As I show above for Element [1E], Thibeault-Saey's CMTS teaches selecting a modulation order (e.g., 16QAM, 32QAM, 64QAM) based on a composite SNR for the modulation profiles of its logical channels. Ex. 1110, ¶¶29-30, 33; *see also*, Section X.A.1.e, *supra*.

110. Thibeault-Saey thus teaches the additional limitations of dependent claim 2 and renders it obvious.

3. Independent Claim 10

a. Element [10A]: "A system comprising: circuitry for use in a cable modem termination system (CMTS), said circuitry comprising a network interface and a processor wherein:"

111. Thibeault's "network" that I discuss above for Element [1B] discloses a "system" as recited in [10A]. Section X.A.1.b, *supra*; Ex. 1110, ¶25, FIGS.1-2. As I further illustrate below in Figure 2, Thibeault discloses that CMTS 10 having circuitry that includes: (i) microprocessor 102 (the claimed "circuitry … comprising a … processor") that receives instructions and data from ROM 104 or RAM 106, and (ii) transmitters 4 and receivers 2 (the claimed "circuitry … comprising a network interface") that provide bi-directional communication with network elements 8. Ex. 1110, ¶¶26-27, FIG. 2.



Ex. 1110, FIG. 2

112. Therefore, Thibeault-Saey teaches Element [10A].

b. Elements [10B]-[10F]

113. I note that Elements [10B]-[10E] are nearly identical to Elements [1B]-[1E], except that Elements [10B]-[10E] recite that the "processor" in the CMTS "is configured to" perform the limitations recited in Elements [1B]-[1E]. Thibeault-Saey teaches that microprocessor 102 in CMTS 10 is configured to perform the limitations described above in Elements [1B]-[1E]. Sections X.A.1.b-e, *supra*; Ex. 1110, ¶26, FIGS. 1-2. Accordingly, for the reasons I provide above for Elements [1B]-[1E], Thibeault-Saey's microprocessor 102 teaches and is configured to perform the limitations recited in Elements [10B]-[10E]. *Id*.

114. Element [10F] is nearly identical to Element [1F], except that Element [10F] recites that the claimed "network interface" is configured to perform the limitations recited in Elements [1F]. Thibeault-Saey teaches that transmitters 4 and receivers 2 (the claimed "network interface") provide communication with network

elements 8. Ex. 1110, ¶27, FIG. 2. Accordingly, for the reasons I provide above, Thibeault-Saey comprises a network interface that teaches and is configured to perform the limitations recited in Element [10F]. *Id.*; Section X.A.1.f, *supra*.

115. Thibeault-Saey therefore renders claim 10 obvious.

4. Dependent Claim 11: "The system of claim 10, wherein said one or more physical layer communication parameter includes one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate."

116. I note that the language of dependent claim 11 is substantially similar to the language of dependent claim 2. Dependent claim 11 is therefore rendered obvious by Thibeault-Saey for the same reasons as dependent claim 2. Section X.A.2, *supra*.

B. Thibeault in View of Gross Renders Claims 1–2 and 10-11 Obvious

1. Independent Claims 1 and 10

c. Elements [1A]-[1C] and Elements [10A]-[10C]

117. For the reasons I describe above for independent claim 1 and independent claim 10, Thibeault discloses Elements [1A]-[1C] and [10A]-[10C]. Sections X.A.1.a-c and X.A.3.a-b, *supra*.

d. Element [1D] and Element [10D]

118. As I discussed above for Element [1C], Thibeault discloses assigning cable modems to logical channels based on a comparison between the determined SNR for each cable modem and SNR thresholds. Although Thibeault does not

explicitly disclose determining a "worst-case" SNR for each group of cable modems in each logical channel, a POSITA would have found it obvious to do so in view of Gross' teachings.

119. Gross teaches a method of setting communication parameters in a communication system between modems that ensures efficient transmission of data despite interruptions and/or disturbances in the network. Ex. 1108, Abstract, ¶¶22, 27. Gross teaches, for example, setting the communication parameter of bit allocation based on a measured carrier's SNR. Ex. 1108, ¶¶14-15, 32, 43, 88. Bit allocation is the number of bits that can be accommodated on a carrier and is dependent on the SNR. Ex. 1108, ¶¶14-15, 32, 88. A POSITA would have recognized this allocation as bit loading, which is a method of allocating the number of bits per symbol and a higher order of modulation to carriers that have higher signal to noise ratio and a lower order modulation to carriers that have lower signal to noise ratio. Ex. 1115, 4:55-59, 8:1-19. A POSITA would have understood that higher order QAM signals would have been capable of transmitting more information compared to lower order QAM signals. Ex. 1112, 16:33-34 ("by moving to a higher QAM modulation order it is possible to transmit more bits per symbol"). Such a POSITA, however, also would have appreciated that a fundamental tradeoff exists between a QAM signal's digital bandwidth and its susceptibility to noise: a higher order QAM signal has a higher digital bandwidth than a lower order QAM signal

but is less resilient to noise (and thus more likely to contain errors) whereas the lower order QAM signal has a lower digital bandwidth but is more tolerant of noise (and thus less likely to contain errors). Ex. 1112, 16:49-55, 30:55-31:8, 31:29-53, FIGS. 6-9 (illustrating QAM constellations with different densities), FIG. 16. A carrier's SNR thus impacts the bit loading of the carrier and thus the carrier's modulation (*e.g.*, 4 bits per symbol (bps) for 16QAM, 5 bps for 32QAM). Ex. 1112, 14:54-16:34; Ex. 1115, 4:55-59, 8:1-19, 9:9-11, 10:55-67, FIG. 10.

120. While Gross teaches setting communication parameters for each carrier, Gross also teaches a simplified approach that uses a single, composite parameter to represent the "worst case" condition for communicating with a group of modems. Ex. 1108, ¶¶44, 100. The SNR of carriers communicating with different modems, for example, may be measured, and the "worst case" SNR may be chosen in order to determine a "worst case" or minimum bit allocation to communicate with any of those modems. Ex. 1108, ¶¶44, 100. A POSITA would have understood that this simplified approach ensures transmission of data to any modem in the group regardless of which modems are activated. Ex. 1108, ¶¶44, 100.

121. A POSITA would have found it obvious to apply Gross' teaching of determining the worst-case SNR for a cable modem group to Thibeault's selection of the optimal modulation order of a logical channel to ensure communication with any modem assigned to that logical channel, regardless of which modems are

activated. Ex. 1108, ¶¶44, 100; Ex. 1110, ¶36, FIG. 6. Thibeault's CMTS already assigns cable modems to logical channels based on comparing a cable modem's SNR measurement with SNR thresholds, which also determines the modulation scheme (*e.g.*, modulation order) that is used for communicating via the logical channel. Ex. 1110, ¶¶15-16, 23-24, 29-30, 33, 38. A POSITA would have recognized that applying Gross' teaching of generating a worst-case SNR-profile for a carrier group would advantageously ensure communication with all cable modems in the group while also furthering Thibeault's goal of ensuring that "each network element [is] running at its best possible modulation mode." Ex. 1110, ¶¶33, 38; Ex. 1108, ¶¶44, 100. A POSITA also would have appreciated that selecting a modulation order (*e.g.*, 16QAM, 32QAM, 64QAM, etc.) for a logical channel based on the worst-case SNR of a cable modem group would advantageously have ensured communication with all cable modems in the group regardless of which cable modems are activated.

122. A POSITA also would have found it obvious to apply Gross' teaching of determining the worst-case SNR for each cable modem group in order to implement Thibeault's dynamic SNR thresholds. Ex. 1110, ¶32. As I further discuss above for Element [1D], Thibeault teaches that its CMTS periodically reconfigures its logical channels, including measuring parameters such as SNR for its cable modems, assigning cable modems to the logical channels, and dynamically setting SNR thresholds used to delineate the logical channels. Ex. 1110, ¶¶32-33,

38; Section X.A.1.d, *supra*. A POSITA, therefore, would have an additional motivation to apply Gross's teaching of generating a worst-case SNR-profile for a carrier group in order to implement Thibeault's dynamic SNR threshold to address variance in a channel's SNR.

123. A POSITA would have found such a combination to be obvious because it would have only required the combination of prior art elements according to known methods to yield predictable results. The prior art elements include Thibeault's CMTS that applies modulation order parameters to CMs that are grouped based on a comparison of the CMs SNR characteristics and SNR thresholds, and Gross's method of determining and applying a worst-case SNR-based parameter for a group of modems based on the individual SNRs of the modems. The known methods include programming of a CMTS. The predictable results include a CMTS that generates a worst-case SNR metric for the CM service group and uses that metric to determine the modulation order applied to the service group and update the SNR threshold for the logical channel.

124. Applying Gross's teachings to Thibeault's CMTS would have been well within the capabilities of a POSITA because it would have involved only minor modifications to the programming of Thibeault's CMTS's microprocessor. Ex. 1110, ¶¶[8-9, 26-27, 39.

125. Thibeault-Gross, therefore, teaches Element [1D] and Element [10D]. Ex. 1117, 53-55; Ex. 1118, 187; Ex. 1119, 8-10.

e. Elements [1E]-[1F] and Elements [10E]-[10F]

126. For reasons similar to those I describe above for Thibeault-Saey, Thibeault-Gross teaches Elements [1E]-[1F] and Elements [10E]-[10F]. Sections X.A.1.e-f and X.A.3.b, *supra*. In particular, Thibeault-Gross' CMTS would have similarly selected the modulation orders for its modulation profiles automatically based on the worst-case SNR metrics determined for the groups of cable modems assigned to its logical channels to ensure communication with all modems in the group while also optimizing the network. Sections X.A.1.e-f and X.A.3.b, *supra*. Thibeault-Gross' CMTS also would have communicated with the cable modems connected to it using the selected modulation orders. Ex. 1110, ¶¶19, 30; *see also* Sections X.A.1.e-f and X.A.3.b, *supra*. In addition, for reasons similar to those described above for Thibeault-Saey, Thibeault-Gross also teaches that its microprocessor is configured to perform the limitations described in Element [10E], and that it comprises a network interface to perform the limitations recited in [10F]. *Id*.

127. Thibeault-Gross, therefore, teaches Elements [1E]-[1F]/[10E]-[10F] and renders claims 1 and 10 obvious.

2. Dependent Claims 2 and 11

128. For reasons similar to those that I describe above for Thibeault-Saey, Thibeault -Gross teaches dependent claim 2 and dependent claim 11. Sections X.A.2 and X.A.4, *supra*. In particular, Thibeault -Gross' CMTS selects a modulation order (e.g., 16QAM, 32QAM) for its modulation profiles. Ex. 1110, ¶36, FIG. 6; *see also* Sections X.A.2 and X.A.4, *supra*. Cooper-Gross' modulation order each teach the claimed "physical layer communication parameter …" as that term is used in the '682 patent. Ex. 1101, 4:63-66.

C. Thibeault in View of Cioffi Render Claims 1-2 and 10-11 Obvious

1. Independent Claims 1 and 10

f. Elements [1A]-[1C] and Elements [10A]-[10C]

129. For the reasons I describe above for independent claim 1 and independent claim 10, Thibeault discloses Elements [1A]-[1C] and [10A]-[10C]. Sections X.A.1.a-c and X.A.3.a-b, *supra*.

g. Element [1D] and Element [10D]

130. As I describe above for Element [1D] and [10D], Thibeault discloses assigning cable modems to logical channels based on a comparison between the determined SNR for each cable modem and SNR thresholds. Although Thibeault does not explicitly disclose determining a "worst-case" SNR for each group of cable modems in each logical channel, a POSITA would have found it obvious to do so in view of Cioffi's teachings.

131. Cioffi teaches a method of managing a communication system between multiple modems by measuring network characteristics and adjusting communication protocols to ensure efficient communications despite signal interference or noise within the network. Ex. 1109, Abstract, ¶¶11-12, 14, 19, 73, 75-76, 112. Cioffi, for example, teaches using measuring network conditions such as SNR to determine the modulation constellation for a channel. Ex. 1109, ¶¶124, 82, 89-92, 95-101, Tables 1-2. A POSITA would have appreciated that the modulation constellation corresponds to the modulation scheme employed as the constellation points correspond to the number of bits that are encoded for each constellation point. Ex. 1109, ¶¶89-93, Table 1. As another example, Cioffi further teaches adaptively selecting different communication parameters to account for varying worst-case noise for each channel, leading to higher performance in the communicating in each channel. Ex. 1109, ¶¶19, 63, 75-76, 112.

132. A POSITA would have found it obvious to apply Cioffi's teaching of selecting a channel's communication parameters based on varying worst-case noise conditions to Thibeault's selection of the optimal modulation order of a logical channel to ensure communication with any modem assigned to that logical channel despite any varying worst-case noise condition in the channel, which advantageously would lead to higher performance for the communications via each channel. Ex. 1109, ¶¶19, 48, 63, 75-76, 112; Ex. 1110, ¶¶4, 16, 23-24, 29-30, 33, 36. As I note

above for the Thibeault-Gross combination, Thibeault's CMTS already assigns cable modems to logical channels based on comparing a cable modems SNR measurement with SNR thresholds, which also determines the modulation scheme (*e.g.*, modulation order) that is used for communicating via the logical channel. Ex. 1110, ¶¶15-16, 23-24, 29-30, 33, 38; Section X.B.1.b, *supra*. A POSITA again would have recognized that applying Cioffi's teaching of generating a worst-case SNR-profile for a carrier group, like the Thibeault-Gross combination, advantageously would ensure communication with all CMs in the group while also furthering Thibeault's goal of ensuring that "each network element [is] running at its best possible modulation mode." Ex. 1110, ¶¶33, 38; Ex. 1109, ¶¶19, 63, 75-76, 82, 89-92, 95-101, 112, 124. As I note above, a POSITA would have appreciated that selecting a modulation order (e.g., 16QAM, 32QAM, 64QAM, etc.) for a logical channel based on the worst-case SNR of a cable modem group would advantageously have ensured communication with all cable modems in the group while also optimizing the network.

133. As I also discussed above for Element [1D], Thibeault further discloses that SNR thresholds may be dynamically determined based on measured network parameters. Ex. 1110, ¶32. Cioffi acknowledges that SNR parameters will vary over time, requiring updating any worst-case assumptions that are relied on. Ex. 1109, ¶112; Section X.A.1.d, *supra*. A POSITA, therefore, would have an additional

motivation to apply Cioffi's teaching of using and updating worst-case SNR profiles for a carrier group in order to implement Thibeault's dynamic SNR threshold to address variance in a channel's SNR. Ex. 1110, ¶32; Ex. 1109, ¶112.

134. A combination of Thibeault and Cioffi also would have been obvious because it would have been the mere combination of prior art elements according to known methods to yield predictable results. The prior art elements include Thibeault's CMTS that applies modulation order parameters to CMs that are grouped based on a comparison of the CMs SNR characteristics and SNR thresholds, and Cioffi's method of relying on worst-case noise measurements to determine the modulation constellation of the channel. The known methods include programming of a CMTS. The predictable results include a CMTS that generates a worst-case SNR metric for the CM service group and uses that metric to determine the modulation applied to the service group and update the SNR threshold for the logical channel.

135. Applying Cioffi's teachings to Thibeault's CMTS would have been well within the capabilities of a POSITA because it would have involved only minor modifications to the programming of Thibeault's CMTS.

136. Therefore, Thibeault-Cioffi teaches Element [1D]. Ex. 1117, 53-55, Ex. 1118, 187; Ex. 1119, 8-10.

h. Elements [1E]-[1F] and Elements [10E]-[10F]

137. For reasons similar to those that I describe above for the Thibeault-Saey and the Thibeault-Gross combinations, Thibeault-Cioffi teaches Elements [1E]-[1F]. Sections X.A.1.e-f and X.B.1.c, *supra*. In particular, Thibeault-Cioffi's CMTS would have similarly selected the modulation orders for its logical channels based on the worst-case SNR metrics determined for the groups of cable modems assigned to the logical channels to ensure communication with any modem assigned to that logical channel despite any varying worst-case noise condition in the channel, leading to higher performance in the communicating in each channel. *See* Section X.A.1.e. Thibeault-Cioffi's CMTS also would have communicated with the cable modems connected to it using the selected modulation orders. Ex. 1110, ¶¶13, 28-29, 34; *see also* Section X.A.1.f.

138. Therefore, Thibeault-Cioffi teaches Elements [1E]-[1F]/[10E]-[10F] and renders claims 1 and 10 obvious.

2. Dependent Claims 2 and 11

139. For reasons similar to those that I describe above for the Thibeault-Saey and Thibeault-Gross combinations, the Thibeault-Cioffi combination teaches dependent claims 2 and 11. Sections X.A.2, X.A.4, and X.B.2, *supra*. In particular, Thibeault-Cioffi's CMTS selects a modulation order (e.g., 16QAM, 32QAM, 64QAM) based on a composite SNR for the modulation profiles of its logical

channels. Section X.B.1.c, *supra*. The Thibeault-Cioffi combination, therefore, teaches the additional limitations recited in dependent claims 2 and 11. The Thibeault-Cioffi combination, therefore, renders dependent claims 2 and 11 obvious.

D. Thibeault in view of Saey and Cooper, Thibeault in view of Gross and Cooper, and Thibeault in view of Cioffi and Cooper Render Claims 7-8 and 16-17 Obvious

1. Dependent Claim 7: "The method of claim 1, comprising assigning said cable modems among said plurality of service groups based on respective distances between said CMTS and said cable modems."

140. Independent claim 1 is taught by the Thibeault-Saey combination, the Thibeault-Gross combination, and the Thibeault-Cioffi combination. Sections X.A.1, X.B.1, and X.C.1, *supra*. Claim 7 depends from independent claim 1 and requires "assigning said cable modems among said plurality of service groups based on respective distances between said CMTS and said cable modems." Ex. 1101, 8:62-65. Cooper discloses the additional limitation of dependent claim 7.

141. As I describe above for Element [1C], Thibeault's CMTS assigns cable modems to logical channels (i.e., a plurality of service groups) based on a comparison between the determined SNR for each cable modem and SNR thresholds. Sections X.A.1.c and X.B.1.a, *supra*. While Thibeault does not teach assigning each cable modem to a group based on its location in the network, Cooper does.

142. Cooper discloses assigning cable modems among a plurality of service groups based on different network parameters. Ex. 1105, Abstract, ¶¶8, 21, 27-28, 37. For example, in addition to assigning network elements to service groups based on SNR measurements, Cooper also discloses a CMTS that assigns network elements to service groups based on determined locations of network elements in a cable network. Ex. 1105, Abstract, ¶¶21, 27-28, 35, 37. Grouping cable modems according to or at least in part according to location of network elements in a cable network would allow the identification and isolation of geographic areas in the network that are problematic and/or the identification and isolation of problematic network elements, which advantageously would have supported proactive maintenance activities. Ex. 1105, ¶19.

143. A POSITA would have found it obvious to modify Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's CMTS to assign cable modems to service groups based on parameters associated with the location of cable modems in a cable network in order to allow for more proactive maintenance of the network. Ex. 1105, ¶19. More specifically, a POSITA would have found it obvious to configure Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's CMTS to determine the location of cable modems in a cable network, and then assign the cable modems among a plurality of service groups based at least in part on such a location thus satisfying claim 7's requirement of "assigning said cable modems among said

plurality of service groups based on respective distances between said CMTS and said cable modems" in order to quickly identify and isolate problematic geographic regions in the network or network elements for maintenance.

144. A POSITA also would have found such modifications to be obvious because they would have merely involved the combination of prior art elements according to known methods to yield predictable results. The prior art elements include Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's CMTS as well as Cooper's methods of assigning cable modems to service groups based on parameters associated with each cable modems location in a cable network. The known methods include programming of a CMTS. The predictable results include a CMTS that is better able to identify and isolate problematic areas in the network or network elements.

145. Applying Cooper's teachings to Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's CMTS would have been well within the capabilities of a POSITA because it would have involved straightforward modifications to the programming of Thibeault-Saey's, Thibeault-Gross', Thibeault-Cioffi's CMTS. Ex. 1110, ¶¶8-9, 26-27, 39; Ex. 1105, ¶¶8, 23-24, 30.

146. Therefore, dependent claim 7 is rendered obvious by the Thibeault-Saey-Cooper combination and the Thibeault-Gross-Cooper combination.

2. Dependent Claim 8: "The method of claim 1, comprising assigning any particular one of said cable modems to one of

> **said plurality of service groups based on which one or more of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems."**

147. Independent claim 1 is taught by the Thibeault-Saey combination, the Thibeault-Gross combination, and the Thibeault-Cioffi combination. Sections X.A.1, X.B.1, and X.C.1, *supra*. Claim 8 depends from independent claim 1 and requires "assigning any particular one of said cable modems to one of said plurality of service groups based on which one or more of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems." Ex. 1101, 8:62-65. Cooper discloses the additional limitation of dependent claim 8.

148. As I describe above for Element [1C], Thibeault's CMTS assigns cable modems to logical channels (i.e., a plurality of service groups) based on a comparison between the determined SNR for each cable modem and SNR thresholds. Sections X.A.1.c and X.B.1.a, *supra*. While Thibeault does not teach assigning each cable modem to a group based on amplifier cascade depth, Cooper does.

149. As I note above for dependent claim 7, Cooper discloses assigning cable modems among a plurality of service groups based on different network parameters. Ex. 1105, Abstract, ¶¶8, 21, 27-28, 37. For example, in addition to assigning network elements to service groups based on SNR measurements, Cooper also discloses a CMTS that assigns network elements to service groups based at least

in part on determined amplifier cascade depths. Ex. 1105, Abstract, ¶¶21, 27-28, 35, 37. Grouping cable modems according to or at least in part according to amplifier cascade depth likewise would allow the identification and isolation of geographic areas in the network that are problematic and/or the identification and isolation of problematic network elements, which again advantageously would have supported proactive maintenance activities. Ex. 1105, ¶19.

150. A POSITA likewise would have found it obvious to modify Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's CMTS to assign cable modems to service groups based on amplifier cascade depth in order to allow for more proactive maintenance of the network. Ex. 1105, ¶19. In particular, a POSITA would have found it obvious to configure Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's CMTS to assign a cable modem to one of a plurality of service groups based at least in part on amplifier cascade depth thus satisfying claim 8's requirement of "assigning any particular one of said cable modems to one of said plurality of service groups based on which one or more of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems" in order to quickly identify and isolate problematic geographic regions in the network or network elements for maintenance.

151. A POSITA also would have found such modifications to be obvious because they would have merely involved the combination of prior art elements

according to known methods to yield predictable results. The prior art elements include Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's CMTS as well as Cooper's methods of assigning cable modems to service groups based on determined amplifier cascade depths. The known methods include programming of a CMTS. The predictable results similarly include a CMTS that is better able to identify and isolate problematic areas in the network or network elements.

152. Applying Cooper's teachings to Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's CMTS would have been well within the capabilities of a POSITA because it would have involved straightforward modifications to the programming of Thibeault-Saey's, Thibeault-Gross', Thibeault-Cioffi's CMTS. Ex. 1110, ¶¶8-9, 26-27, 39; Ex. 1105, ¶¶8, 23-24, 30.

153. Therefore, dependent claim 8 is rendered obvious by the Thibeault-Saey-Cooper combination and the Thibeault-Gross-Cooper combination.

3. Dependent Claim 16: "The system of claim 10, wherein said processor is configured to assign said cable modems among said plurality of service groups based on respective distances between said CMTS and said cable modems."

154. Dependent claim 16 is substantially similar to dependent claim 7. Dependent claim 16, however, recites that "said processor" makes the assignments. Ex. 1101, 10:30-33. As I discuss above for Element [10A], Thibeault-Saey-Cooper's, Thibeault-Gross-Cooper's, and Thibeault-Cioffi-Cooper's CMTS comprises the claimed processor, and the processor is configured to perform the

claimed limitations recited in dependent claim 16 as I discussed in claim 7. Sections X.A.3.a and X.D.1, *supra*. Dependent claim 16, therefore, is rendered obvious for the same reasons I discuss above. *Id.*

4. Dependent Claim 17: "The system of claim 10, wherein said processor is configured to assign each of said cable modems among said plurality of service groups based on one or more branch amplifier that serves said each of said cable modems."

155. Dependent claim 17 is substantially similar to dependent claim 8. Dependent claim 17, however, recites that "said processor" makes the assignments. Ex. 1101, 10:34-37. As I again discuss above for Element [10A], Thibeault-Saey-Cooper's, Thibeault-Gross-Cooper's, and Thibeault-Cioffi-Cooper's CMTS comprises the claimed processor, and the processor is configured to perform the claimed limitations recited in dependent claim 17 as I discussed in claim 8. Sections X.A.3.a and X.D.2, *supra*. Dependent claim 17, therefore, is rendered obvious for the same reasons I discuss above. *Id.*

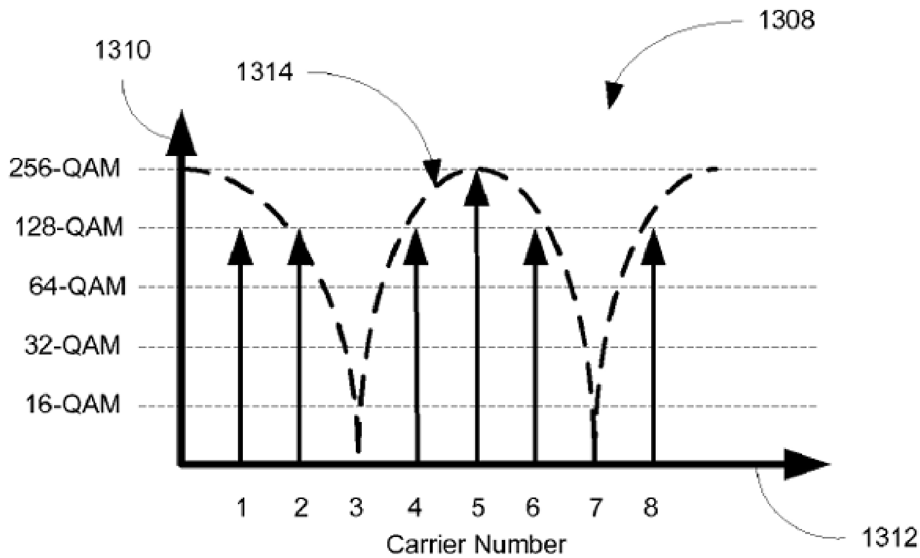
E. Thibeault in View of Saey and Monk-802, Thibeault in View of Gross and Monk-802, or Thibeault in View of Cioffi and Monk-802 Render Claims 3-6 and 12-15 Obvious

1. Dependent Claim 3: "The method of claim 1, wherein said CMTS uses orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers for said communicating."

156. Claim 3 depends from independent claim 1. Ex. 1101, 8:29-32. As I discuss above for Elements [1D] and [1F], the Thibeault-Saey, Thibeault-Gross, and Thibeault-Cioffi combinations teach a CMTS that selects a physical layer

communication parameter (*i.e.*, a modulation order), which is then used to communicate with one or more cable modems in a particular service group. Sections X.A.1.d-f, X.B.1.b-c, and X.C.1.b-c, *supra*. While the Thibeault-Saey, Thibeault-Gross, and Thibeault-Cioffi combinations do not teach communicating using OFDM over a plurality of subcarriers, Monk-802 does.

157. Monk-802 discloses a method of communication using OFDM. Ex. 1114, 8:1-39, 17:61-67, 19:27-41, 21:19-22:34, FIGS. 12, 13A-C. Specifically, Monk-802 discloses dividing a waveform into multiple sub-carriers, each of which is independent and can be modulated on a per-subcarrier basis depending on the channel's SNR, with higher SNR channels supporting higher data capacity or modulation schemes. Ex. 1114, 8:19-39, 21:19-22:34. Monk-802's Figure 13B, included below, for example, shows the frequency profile of a carrier frequency with eight sub-carriers, each with different QAM orders (*e.g.*, 16, 32, 64, 128, 256) based on the frequency response of each sub-carrier, which corresponds to that subcarrier's SNR. Ex. 1114, 21:53-22:16, FIGS. 13A-13C; *see also* Ex. 1114, 8:19-25, 20:59-21:43.



Ex. 1114, FIG. 13B

158. OFDM helps cable broadband coaxial networks overcome signal impairments caused by issues such as multipath reflects in a highly dispersive environment (*e.g.*, an in-house coaxial network). Ex. 1114, 4:7-24, 8:8-25.

159. A POSITA would have been motivated to combine the OFDM communication techniques taught by Monk-802 with the communication techniques taught by Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's CMTS as an additional method to address signal impairments in a highly dispersive environment. Ex. 1114, 4:7-24, 8:8-25. As I discuss above for element [1E], Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's communication techniques teach selecting different modulation orders for different carriers or channels based on a composite worst-case SNR. Monk-802's OFDM communication technique advantageously would allow for higher quality and more reliable services in highly dispersive environments by splitting up each logical channel further and allowing bits to be

spread over multiple subcarriers, while still utilizing different modulation orders of QAM but on a per-subcarrier basis depending on an SNR. Sections X.A.1.e, X.B.1.c, and X.C.1.c, *supra*.

160. The Thibeault-Saey, Thibeault-Gross, and Thibeault-Cioffi combinations also would have been obvious because they would have been merely the combination of prior art elements according to known methods to yield predictable results. The prior art elements include Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's CMTS as well as Monk-802's OFDM method. The known methods include programming a CMTS. The predictable results include a CMTS that uses OFDM to communicate over a plurality of subcarriers that use different modulation orders of QAM on a per-subcarrier basis.

161. A POSITA would have had a reasonable expectation of success applying Monk-802's teachings to Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's CMTS as it would have only required routine modifications to the programing of the microprocessor in the CMTS, which was well within the capabilities of a POSITA. Ex. 1110, ¶¶8-9, 26-27. Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's CMTS as modified by Monk-802, therefore, teaches the claimed use of "[OFDM] over a plurality of subcarriers for said communicating."

162. Therefore, claim 3 is invalid as obvious over the Thibeault-Saey-Monk-802, Thibeault-Gross-Monk-802, and Thibeault-Cioffi-Monk-802 combinations.

2. Dependent Claim 4: "The method of claim 3, comprising selecting, by said CMTS, said one or more physical layer communication parameter on a per-OFDM-subcarrier basis."

163. Claim 4 depends from claim 3. Ex. 1101, 8:33-35. As I discuss above for dependent claim 3, Thibeault-Saey-Monk-802's, Thibeault-Gross-Monk-802's, and Thibeault-Cioffi-Monk-802's CMTS teaches the use of OFDM where a particular QAM modification order (*e.g.*, 16, 32, 64, 128, 256) is selected on a per-subcarrier basis depending on a SNR. Section X.E.1, *supra*; Ex. 1114, 8:19-39, 21:19-22:34, FIGS. 12, 13A-C. Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's CMTS as modified by Monk-802, therefore, also teaches the CMTS "selecting … said one or more physical layer communication parameter on a per-OFDM-subcarrier basis."

164. Dependent claim 4, therefore, is invalid as obvious over the Thibeault-Saey-Monk-802, Thibeault-Gross-Monk-802, and Thibeault-Cioffi-Monk-802 combinations.

3. Dependent Claim 5: "The method of claim 4, wherein said one or more physical layer communication parameter includes one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS."

165. Claim 5 depends from claim 4. Ex. 1101, 8:36-40. As I discuss above for Element [1E] and dependent clam 4, Thibeault-Saey-Monk-802's, Thibeault-Gross-Monk-802's, and Thibeault-Cioffi-Monk-802's CMTS selects "one or more

physical layer communication parameter" on a per-OFDM-subcarrier basis based on a composite SNR-related metric. Sections X.A.1.e, X.B.1.c, and X.E.2, *supra*. Thibeault also discloses the use of DOCSIS CMTSs and modems, which transmit and receive in different, designated frequency bands that would determine which frequencies of OFDM subcarriers are used for communication between equipment. Ex. 1110, Abstract, ¶¶1-7, 31, 37; Ex. 1121, 1, 19, 23-25; Ex. 1122, 1, 21-24; Ex. 1123, 1, 21, 43, 45. This is consistent with Monk-802's disclosure, which also shows different frequency bands used for upstream and downstream signals. Ex. 1114, 23:30-60, 24:4-37, FIG. 17. The following table summarizes the physical layer bandwidth and data rate for DOCSIS 1.0 and DOCSIS 2.0. For downstream channel bandwidth, both DOCSIS standards use 6 MHz or channels. Ex. 1121, 23-24, (§§2.2.1, 2.3.1); Ex. 1123, 19 (§1.1.1), 43 (§4.2.1), 44-46 (§4.3.1). For upstream channel bandwidth, DOCSIS 1.0 uses channel widths between 200 kHz and 3.2 MHz, and DOCSIS 2.0 uses channel widths between 200 kHz and 6.4 MHz. Ex. 1121, 40 (§4.2.2.3), 52 (§4.2.13); Ex. 1123, 93 (§6.2.16). For modulating upstream data, DOCSIS 1.0 uses QPSK or 16QAM, and DOCSIS 2.0 can use QPSK, 8QAM, 16QAM, 32QAM, 64QAM, and 128QAM with trellis coded modulation in S-CDMA mode (with an effective spectral efficiency equivalent to that of 64QAM). Ex. 1121, 13, 37-40 (§§4.2.1-2); Ex. 1123, 81-88 (§6.2.13), 113 (§6.2.23), 153-154 (Table 8–19).

	DOCSIS 1.0 (February 1997)	DOCSIS 2.0 (December 2001)
Access Method	TDMA	TDMA and S-CDMA
Downstream Bandwidth	6 MHz	6 MHz
Downstream Modulation	64QAM, 256QAM	64QAM, 256QAM
Upstream Channel Width	200 kHz to 3.2 MHz	200 kHz to 6.4 MHz
Upstream Modulation	QPSK, 16QAM	QPSK, 8QAM, 16QAM, 64QAM, 128QAM with Trellis Coded Modulation (TCM)

Ex. 1121, 13, 23-25, (§§2.2.1, 2.3.1), 37-40 (§§4.2.1-2), 40 (§4.2.2.3), 52 (§4.2.13), 53 (§4.3.4); Ex. 1123, 19 (§1.1.1), 43 (§4.2.1), 44-45 (§4.3.1), 58-61 (§§6.2.1-2), 61-62 (§6.2.3), 81-88 (§6.2.13), 93 (§6.2.16), 113 (§6.2.23), 114 (§6.3.3), 153-154 (Table 8–19).

166. As I also discuss above for Element [1B], Thibeault further discloses that the CMTS determines separate upstream (*i.e.*, "transmission to said CMTS") and downstream (*i.e.*, "reception of information from said CMTS") SNR metrics. Ex. 1110, ¶¶31-37; Section X.A.1.b, *supra*. Given that Thibeault distinguishes between upstream and downstream SNR metrics in different frequency bands, Thibeault-Saey-Monk-802's, Thibeault-Gross-Monk-802's, and Thibeault-Cioffi-Monk-802's CMTS teaches selecting a separate upstream and downstream "one or

more physical layer communication parameter" on a per-OFDM-subcarrier basis based on a composite upstream or downstream SNR-related metric. Thibeault-Saey-Monk-802's, Thibeault-Gross-Monk-802's, and Thibeault-Cioffi-Monk-802's CMTS teaches "one or more physical layer communication parameter includes one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS" as claimed.

167. Dependent claim 5, therefore, is invalid as obvious over the Thibeault-Saey-Monk-802, Thibeault-Gross-Monk-802, and Thibeault-Cioffi-Monk-802 combinations.

4. Dependent Claims 6

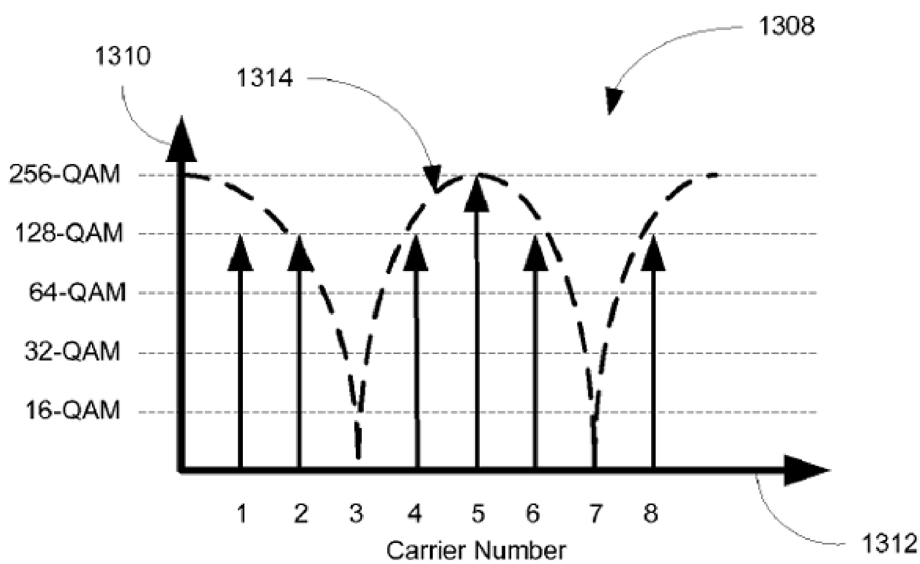
a. Element [6A]: "The method of claim 1, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a particular cable modem has a particular SNR versus frequency profile; and"

168. Claim 6 depends from claim 1. Ex. 1101, 8:41-61. As I show above for Element [1C], Thibeault assigns cable modems into at least four different service groups or logical channels based on comparing a modem's measured SNR to an SNR threshold. Ex. 1110, ¶33; Section X.A.1.c, *supra*. Thibeault-Saey, Thibeault-Gross,

and Thibeault-Cioffi thus teach at least "a first service group and a second service group."

169. As I also show above for Element [1D], the Thibeault-Saey, Thibeault-Gross, and the Thibeault-Cioffi combinations teach generating a composite SNR-related metric for each service group based at least in part on a worst-case SNR profile. Sections X.A.1.d, X.B.1.b, and X.C.1.b, *supra*. Although Thibeault-Saey, Thibeault-Gross, and Thibeault-Cioffi do not expressly describe these composite SNRs as SNR versus frequency profiles, Monk-802 does.

170. As I show below, Monk-802's Figure 13B shows a profile of a carrier frequency response, which corresponds to that subcarrier's SNR, over a range of frequencies. Ex. 1114, 21:53-22:16, FIGS. 13A-13C; *see also* Ex. 1114, 8:19-25, 20:59-21:43.



Ex. 1114, FIG. 13B

171. Monk-802's Figure 13B shows a SNR versus frequency profile similar to line 222 in Figure 2B of the '682 patent copied below.

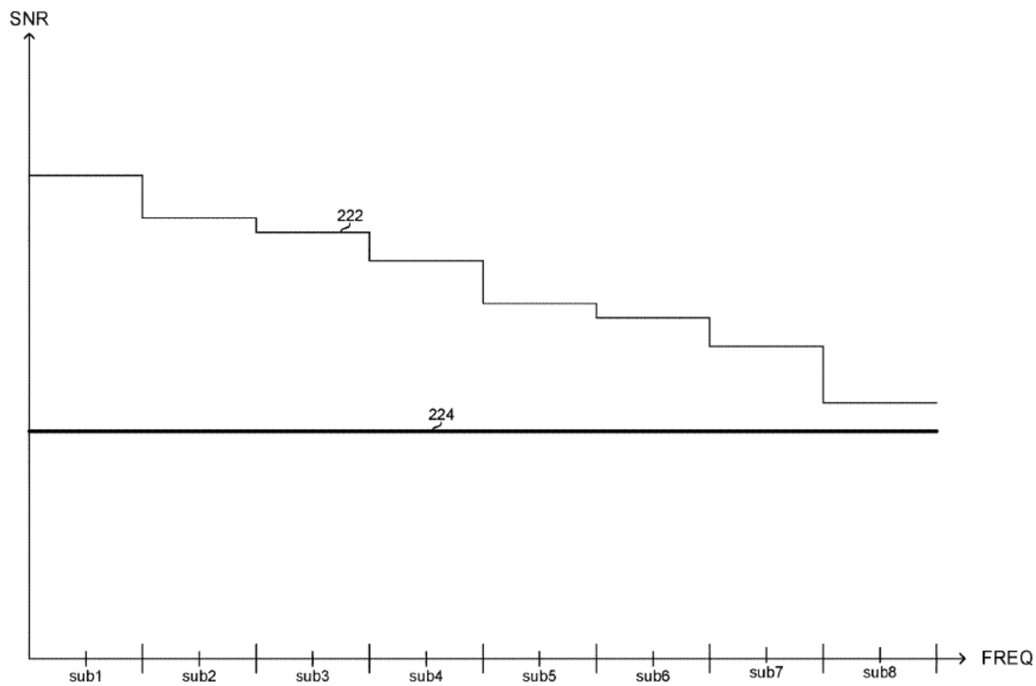


FIG. 2B

Ex. 1101, FIG. 2B.

Compare Ex. 1101, 4:6-17, FIG. 2B; *with* Ex. 1114, 21:53-22:16, FIG. 13B. As seen above, an SNR profile over a range of frequencies indicates the maximum modulation order for each frequency band. *See* Ex. 1114, 8:19-39, 21:19-22:34.

172. A POSITA would have found it obvious to apply Monk-802's teachings of determining an SNR profile over a range of frequencies to Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's method of determining an SNR metric in order optimize modulation order by both SNR and frequency. *See* Ex. 1114, 8:19-39, 21:19-22:34; Sections X.A.1.b, X.B.1.a, and X.C.1.a, *supra*. Although Thibeault

discusses modems communicating in dedicated bands of frequencies, Monk-802's methods would allow the CMTS of Thibeault-Saey, Thibeault-Gross, and Thibeault-Cioffi to divide those frequency bands into multiple channels and determine which frequency band best suites each communication. *See* Ex. 1110, ¶2. When assigning each cable modem to a plurality of service groups based on an SNR versus frequency profile, for example, a CMTS would assign modems by their SNR versus frequency profile rather than singular SNR thresholds.

173. Similarly, and for reasons similar to those I explain above for Element [1D] regarding modems that have been assigned to a service group, a POSITA would have also found it obvious to apply Monk-802's teaching to Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's CMTS in order to determine a first composite SNR versus frequency profile for each service group so as to determine an optimal modulation order and optimal frequency band for each of Thibeault's logical channels as well as to dynamically adjust thresholds based on measured these measured composite SNR versus frequency profile. Ex. 1110, ¶¶16, 23, 32-38; Sections X.A.1.d, X.B.1.b, and X.C.1.b, *supra*.

174. Implementing this combination would have been the mere combination of prior art elements according to known methods to yield predictable results. The prior art elements include Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's CMTS that measures and assigns modems to service groups based on their

measured SNR, and determines a worst-case SNR for each group as well as Monk-802's method of measuring a modem's SNR over a range of frequencies. The known methods include programing of a CMTS. The predictable results include a CMTS that measures and assigns modems to service groups based on their measured SNR versus frequency profile, and determines a composite SNR versus frequency profile for each group.

175. Applying Monk-802's teachings to Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's CMTS would have been well within the capabilities of a POSITA and would have involved only routine modifications to the programming of the CMTS. *See* Ex. 1110, ¶¶8-9, 26-27.

176. The combinations of Thibeault-Saey-Monk-802, Thibeault-Gross-Monk-802, and Thibeault-Cioffi-Monk-802, therefore, teach the claimed "first composite SNR versus frequency profile" and "second composite SNR versus frequency profile" associated with their respective service group. Further, because these combinations also teach measuring a SNR versus frequency profile for each modem, the combinations also teach "a particular cable modem has a particular SNR versus frequency profile" as claimed.

177. The Thibeault-Saey-Monk-802, Thibeault-Gross-Monk-802, and Thibeault-Cioffi-Monk-802 combinations thus teach the additional requirements of Element [6A].

b. Element [6B]: "said assigning said each cable modem among said plurality of service groups comprises, for the particular cable modem: assigning said particular cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and assigning said particular cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile."

178. As I discussed for Element [6A], the Thibeault-Saey-Monk-802, Thibeault-Gross-Monk-802, and Thibeault-Cioffi-Monk-802 combinations teach at least a first and second service group that each have their own composite SNR versus frequency profile. Section X.E.4.a, *supra*. The Thibeault-Saey-Monk-802, Thibeault-Gross-Monk-802, and Thibeault-Cioffi-Monk-802 combinations also teach "a particular cable modem has a particular SNR versus frequency profile" as claimed. *Id*. The Thibeault-Saey-Monk-802, Thibeault-Gross-Monk-802, Thibeault-Cioffi-Monk-802 combinations also teach assigning the particular cable modem to the service group that has a composite SNR versus frequency profile most similar to the particular SNR versus frequency profile of the particular cable modem as required by Element [6B].

179. Thibeault discloses that modems are assigned to logical channels based on their individual measured values compared with the threshold values. Ex. 1110, ¶¶9, 11, 32. Thibeault also discloses that these thresholds can be dynamic and

updated based on network measurements. Ex. 1110, ¶32. Thibeault then teaches assigning or reassigning modems to logical channels based on these updated thresholds. Ex. 1110, ¶32. Based on these teachings in Thibeault, therefore, the Thibeault-Saey-Monk-802, Thibeault-Gross-Monk-802, and Thibeault-Cioffi-Monk-802 combinations teach assigning the particular modem to the service group with a composite SNR versus frequency profile that is the most similar to the modem's particular SNR versus frequency profile.

180. Dependent claim 6, therefore, is invalid as obvious over the Thibeault-Saey-Monk-802, Thibeault-Gross-Monk-802, and Thibeault-Cioffi-Monk-802 combinations.

5. Dependent Claims 12: "The system of claim 10, wherein said network interface and said cable modems are configured to communicate using orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers."

181. Dependent claim 12 is substantially similar to dependent claim 3. Dependent claim 12, however, recites that "said network interface and said cable modems" are configured to use OFDM. Ex. 1101, 9:41-44. As I discuss above or Element [10A], Thibeault-Saey-Cooper's, Thibeault-Gross-Cooper's, Thibeault-Cioffi-Cooper's CMTS comprises the claimed network interface that it uses to communicate with the cable modems. Sections X.A.3.a and X.E.1, *supra*. Dependent claim 12, therefore, is rendered obvious for the same reasons I discuss above. *Id.*

6. Dependent Claim 13: "The system of claim 12, wherein said network interface is configured such that at least one of said one or more physical layer communication parameters are configurable on a per-OFDM-subcarrier basis."

182. Dependent claim 13 is substantially similar to dependent claim 4. Dependent claim 13, however, recites that "said network interface" is configured to use OFDM. Ex. 1101, 9:45-10:2. As I discuss above for Element [10A], Thibeault-Saey-Cooper's, Thibeault-Gross-Cooper's, Thibeault-Cioffi-Cooper's CMTS comprises the claimed network interface that it uses to communicate with the cable modems. Sections X.A.3.a and X.E.2, *supra*. Dependent claim 13, therefore, is rendered obvious for the same reasons discuss above. *Id.*

7. Dependent Claim 14: "The system of claim 12, wherein said one or more physical layer communication parameter includes one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS."

183. Dependent claim 14 is substantially similar to dependent claim 5. Dependent claim 14, therefore, is rendered obvious by the Thibeault-Saey-Monk-802, Thibeault-Gross-Monk-802, and Thibeault-Cioffi-Monk-802 combinations for the same reasons. Section X.E.3, *supra*.

8. Dependent Claim 15: "The system of claim 10, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a particular cable modem has a particular SNR versus

> **frequency profile; said assignment of said each cable modem among said plurality of service groups comprises, for the particular cable modem: assignment of said particular cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and assignment of said particular cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile."**

184. Dependent claim 15 is substantially similar to dependent claim 6. Dependent claim 15, therefore, is rendered obvious by the Thibeault-Saey-Monk-802, Thibeault-Gross-Monk-802, and Thibeault-Cioffi-Monk-802 combinations for the same reasons. Section X.E.4, *supra*.

F. Thibeault in View of Saey and Monk and Cooper-437, Thibeault in View of Gross and Monk and Cooper-437, or Thibeault in View of Cioffi and Monk and Cooper-437 Render Claims 9 and 18 Obvious

1. Dependent Claim 9: "The method of claim 1, wherein said determining said plurality of SNR-related metrics comprises: transmitting a probe message to each cable modem, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and receiving a metric reporting message from each cable modem."

185. Claim 9 depends from independent claim 1. Ex. 1101, 9:4-11. As I discuss above for Element [1B], the Thibeault-Saey, Thibeault-Gross, and Thibeault-Cioffi combinations teach determining a SNR-related metric for each cable modem served by the CMTS based on a measurement at either the CMTS or the CM. Sections X.A.1.b, X.B.1.a, and X.C.1.a, *supra*. Thibeault explains that the

processes illustrated in Figure 4 may be contained on a computer readable medium which may be read by microprocessor. Ex. 1110, ¶39; *see also* Section X.A.1.b, *supra*. Thibeault discloses that any of its cable modems may include a microprocessor configured to perform the processes of Figure 4 and further configured to provide ranging messages to the CMTS indicative of the cable modem's SNR. Ex. 1110, ¶¶13, 32, 39. These combinations, however, do not teach a probe message that initiates the measurement of the SNR-related metric at the cable modems or that includes instructions for measuring a metric and reporting said measured metric back to the CMTS (as required by claim 9), but such a probe message is taught by Monk and Cooper-437.

186. Monk discloses a method of communication over a broadband network that relies on different modulation schemes based on a communication channel's SNR. Ex. 1115, Abstract, 4:25-38, 6:6-19, 7:14-31, 8:1-11. Monk, for example, teaches that higher SNR channels can support higher modulation orders through bit loading (e.g., 16QAM, 64QAM and 256QAM), while lower SNR channels may use a different modulation scheme such as QPSK. Ex. 1115, 4:55-59, 8:1-11, 9:9-11, 10:58-62. To determine the SNR of a channel, Monk discloses a sending node transmitting a probe message having a predetermined data sequence to a receiving device, which analyzes the probe message for impairment. Ex. 1115, 4:44-59, 9:28-41, Abstract. The receiving device sends the results of the analysis back to the

sending device as either raw data or a bit loading profile for the sending device to determine the transmission parameters. Ex. 1115, 9:41-50.

187. A POSITA would have found it obvious to transmit a probe message to each cable modem (the claimed "transmitting a probe message to each cable modem") and to receive a reporting message including SNR raw data or a bit loading profile (the claimed "receiving a metric reporting message from each cable modem") as taught by Monk in order to implement Thibeault's example of measuring an SNR-related metric at each cable modem and reporting it back to the CMTS. Ex. 1110, ¶13; Ex. 1115, 4:44-59, 8:4-5, 9:9-11, 9:26-41, 10:60-62, Abstract.

188. Incorporating Monk's probe messages and reporting messages into the Thibeault-Saey, Thibeault-Gross, and Thibeault-Cioffi combinations also would have been obvious because such an implementation would be the mere combination of prior art elements according to known methods to yield predictable results. The prior art elements include Thibeault-Saey's/Thibeault-Gross's/Thibeault-Cioffi's CMTS, and the probe messages and reporting messages of Monk. The known methods include programming the CMTS to send probe messages and receive reporting messages that provide an analysis of a channel's SNR. The predictable results include a system that uses probe messages and reporting messages to have cable modems rather than a CMTS measure the SNR of a channel. A POSITA would

have further found it obvious to measure at the CMs to distribute processing requirements among multiple CMs.

189. Applying Monk's teachings to Thibeault-Saey's, Thibeault-Gross', and Thibeault-Cioffi's CMTS would have been well within the capabilities of a POSITA as it would have only required minor modifications to the programing of the microprocessor in the CMTS. A POSITA would have a reasonable expectation of success in these programming modifications as Thibeault-Saey's, Thibeault-Gross's, Thibeault-Cioffi's microprocessor would function as a programmed signal processor, which Monk discloses may be used for its teachings. Ex. 1111, ¶39; Ex. 1115, 10:22-31.

190. Although the Thibeault-Saey-Monk, Thibeault-Gross-Monk, and Thibeault-Cioffi-Monk combinations teach a probe message, these combinations do not teach a probe message that includes instructions for measuring a metric and reporting said measured metric back to the CMTS. Cooper-437, however, does. Cooper-437 discloses a method for a CMTS to ask for and receive specific noise signal power measurements from cable modems in its network. Ex. 1116, Abstract, 1:62-65, 3:47-50, FIG. 1. Cooper-437, for example, describes a CMTS initiating noise signal power measurements by transmitting to cable modems in the network a message that defines the measurement techniques to be used and how to report the measurements. Ex. 1116, 8:11-29, 8:60-9:5, 10:56-11:28, Table 1.

191. After receiving the probe message, a cable modem performs the noise signal power measurements specified in the message, and then sends a report of the measurements (which may be provided as raw measured data). Ex. 1116, 10:56-11:28, Table 1. By including the measurement and reporting modes (i.e., instructions) in the message, Cooper-437's method allows a CMTS to send customized probe messages to specific modems to conduct specific testing (*e.g.*, at specific frequencies or at specific noise thresholds), which can be adjusted as different noise sources connect or are active on the network. Ex. 1116, 8:9-64, 10:56-11:28, Table 1.

192. A POSITA would have found it obvious to modify the probe message in the Thibeault-Saey-Monk, Thibeault-Gross-Monk, and Thibeault-Cioffi-Monk combinations, which already estimates channel characteristics, to identify a measurement mode and reporting mode, as taught by Cooper-437, which advantageously would have allowed Thibeault-Saey-Monk's, Thibeault-Gross-Monk's, and Thibeault-Cioffi-Monk's CMTS to send customized probe messages to specific CMs or service groups to determine the SNR of specific service groups or at specific frequencies. Ex. 1116, 8:9-64, 10:56-11:28, Table 1. Such a modification advantageously would allow a CMTS to more quickly identify groups of modems or frequencies that have had a change in their SNR.

193. Modifying the probe message to identify a measurement mode (the claimed "instructions for measuring a metric") and a reporting mode (the claimed "instructions for … reporting said measured metric") would have been the mere combination of prior art elements according to known methods to yield predictable results. The prior art elements include Thibeault-Saey-Monk's, Thibeault-Gross-Monk's, and Thibeault-Cioffi-Monk' probe message as well as the measurement mode and reporting mode of Cooper-437. The known methods include modifying the contents of a probe messages. The predictable results include a CMTS that uses probe messages that include instructions for measurement and reporting of SNR-related metrics.

194. Applying Cooper-437's teachings to Thibeault-Saey-Monk's, Thibeault-Gross-Monk's, and Thibeault-Cioffi-Monk's CMTS would have been well within the capabilities of a POSITA as it would have only required minor modifications to the programing of the microprocessor in the CMTS. A POSITA would have a reasonable expectation of success in these programming modifications as the Thibeault-Saey-Monk, Thibeault-Gross-Monk, and Thibeault-Cioffi-Monk combinations as well as Cooper-437 each teach using the DOCSIS standard for transfer of data over a cable system and rely on generic microprocessors or microcontrollers for execution of their methods. Ex. 1105, ¶¶13, 37, 39; Ex. 1116, 5:3-14, 7:6-22.

195. Each of Thibeault-Saey, Thibeault-Gross, and Thibeault-Cioffi in view of Monk and Cooper-437, therefore, teach dependent claim 9.

2. Dependent Claim 18: "The system of claim 10, wherein said determination of said plurality of SNR-related metrics comprises: transmission, via said network interface, of a probe message to each cable modem, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and reception, via said network interface of said CMTS, of a metric reporting message from each cable modem."

196. Dependent claim 18 is substantially similar to dependent claim 9. Dependent claim 18, therefore, is rendered obvious by the Thibeault-Saey-Monk-Cooper-437, Thibeault-Gross-Monk-Cooper-437, and Thibeault-Cioffi-Monk-Cooper-437 combinations for the same reasons.

XI. CONCLUSION

197. All of the statements made in this declaration of my own knowledge are true. All statements made based on information and belief are believed to be true. Further, these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code.

Date: Feb 14-2024

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Sayfe Kiaei

XII. CLAIM LISTING APPENDIX

U.S. Pat. No. 10,135,682

Designation	Claim Language
Claim 1	
[1A]	1. A method comprising:
[1B]	determining, by a cable modem termination system (CMTS), for each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;
[1C]	assigning, by said CMTS, each cable modem among a plurality of service groups based on a respective corresponding SNR-related metric;
[1D]	generating, by said CMTS for each one of said plurality of service groups, a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups;
[1E]	selecting, by said CMTS, one or more physical layer communication parameter to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and
[1F]	communicating, by said CMTS, with one or more cable modems corresponding to said one of said plurality of service groups using said selected one or more physical layer communication parameter.
Claim 2	
2	2. The method of claim 1, wherein said one or more physical layer communication parameter includes one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate.
Claim 3	
3	3. The method of claim 1, wherein said CMTS uses orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers for said communicating.

Designation	Claim Language
Claim 4	
4	4. The method of claim 3, comprising selecting, by said CMTS, said one or more physical layer communication parameter on a per-OFDM-subcarrier basis.
Claim 5	
5	5. The method of claim 4, wherein said one or more physical layer communication parameter includes one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.
Claim 6	
[6A]	6. The method of claim 1, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a particular cable modem has a particular SNR versus frequency profile; and
[6B]	said assigning said each cable modem among said plurality of service groups comprises, for the particular cable modem: assigning said particular cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and assigning said particular cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile.
Claim 7	
7	7. The method of claim 1, comprising assigning said cable modems among said plurality of service groups based on respective distances between said CMTS and said cable modems.
Claim 8	

Designation	Claim Language
8	8. The method of claim 1, comprising assigning any particular one of said cable modems to one of said plurality of service groups based on which one or more of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems.
Claim 9	
9	9. The method of claim 1, wherein said determining said plurality of SNR-related metrics comprises: transmitting a probe message to each cable modem, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and receiving a metric reporting message from each cable modem.
Claim 10	
[10A]	10. A system comprising: circuitry for use in a cable modem termination system (CMTS), said circuitry comprising a network interface and a processor wherein:
[10B]	said processor is configured to determine, for each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;
[10C]	said processor is configured to assign each of said cable modems among a plurality of service groups based on a respective corresponding SNR-related metric;
[10D]	said processor is configured to generate, for each one of said plurality of service groups, a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups;
[10E]	said processor is configured to select one or more physical layer communication parameter to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and
[10F]	said network interface is configured to communicate with one or more cable modems corresponding to said one of said plurality of service groups using the one or more selected physical layer communication parameter.
Claim 11	

Designation	Claim Language
11	11. The system of claim 10, wherein said one or more physical layer communication parameter includes one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate.
Claim 12	
12	12. The system of claim 10, wherein said network interface and said cable modems are configured to communicate using orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers.
Claim 13	
13	13. The system of claim 12, wherein said network interface is configured such that at least one of said one or more physical layer communication parameters are configurable on a per-OFDM-subcarrier basis.
Claim 14	
14	14. The system of claim 12, wherein said one or more physical layer communication parameter includes one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.
Claim 15	
15	15. The system of claim 10, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a particular cable modem has a particular SNR versus frequency profile; said assignment of said each cable modem among said plurality of service groups comprises, for the particular cable modem: assignment of said particular cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and assignment of said particular

Designation	Claim Language
	cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile.
Claim 16	
16	16. The system of claim 10, wherein said processor is configured to assign said cable modems among said plurality of service groups based on respective distances between said CMTS and said cable modems.
Claim 17	
17	17. The system of claim 10, wherein said processor is configured to assign each of said cable modems among said plurality of service groups based on one or more branch amplifier that serves said each of said cable modems.
Claim 18	
18	18. The system of claim 10, wherein said determination of said plurality of SNR-related metrics comprises: transmission, via said network interface, of a probe message to each cable modem, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and reception, via said network interface of said CMTS, of a metric reporting message from each cable modem.